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RESEARCH REVIEW

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The RESEARCH REVIEW is a quarterly supplement published by TRAFFIC SAFETY for the reporting of research that relates to traffic safety. This service is designed to provide those who conduct research, and/or utilize research findings, information that contributes to, advances, or clarifies the body of traffic safety knowledge. The value of research and the prevention of duplication and overlap is enhanced by prompt reporting. To fulfill this purpose, the RESEARCH REVIEW will present completed reports, abstracts, summaries of research in progress, and information regarding contemplated research.

The opinions expressed and conclusions drawn are entirely those of the various authors of these papers. TRAFFIC SAFETY and the National Safety Council accept no responsibility for them, and publication should not be deemed as either endorsement or approval of the ideas expressed or devices described.

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TRAFFIC SAFETY RESEARCH PROJECTS

Annual Listing

THE following is a list of research projects known to the National Safety Council. Many of these are as yet uncompleted, while others have recently been published.

Each project has been assigned a library classification number used by the Bureau of Highway Traffic at Yale University. Each number is a subdivision of the following principal headings:

000 General	500 Law
100 Road Users	600 Education
200 Vehicles	700 Administration
300 Fixed Facilities	800 Economics and Sociological Aspects
400 Traffic Characteristics and Controls	900 Planning

Titles appear in quotes; previous publication journals and dates are given when known. Name and address of place where project is being carried on follows, with principal investigator's name. Cooperating or sponsoring agencies are listed when possible. (Short summaries of many projects are available, but more complete information can be obtained from a project's researchers.)

Reports of new research will be abstracted and presented here in the earliest possible issue. Each March issue will contain a revised listing similar to that below, of all projects received during the preceding year.

In-Process:

101 "An Investigation Concerning Certain Rational Correlates of Driver Behavior" — J. L. Fine, (Safety Educ. Proj., Teachers College, Columbia U.), Feb. 60.

101 "Classification of Youthful Drivers by Means of Psychological Tests"—C. F. Haner, Prof., Dept. of Psychology, Grinnell College, Grinnell, Iowa. Sponsor: Farmers Mutual Reinsurance Co. (821 Fifth St., Grinnell, Iowa). Sept. 1, 1959. A description of the program and progress report appeared in *The National Underwriter,* (175 W. Jackson Blvd., Chicago 4, Ill.) No. 35, Aug. 26, 1960.

101 "The Police and the Surgeon at Falu Hospital, Sweden"—S. Lindgren, Falu Hospital, Falun, Sweden; 55.

130 "Development of a Criterion for Driver Behavior"—E. J. Shoben, Jr., Prof. of Education, Dept. of Psychological Foundations and Services; and J. L. Fine, Research Asst., Dept. of Psych. Foundations and Services, Teachers College, Columbia U. (525 West 120th St., New York 27, N. Y., (J. Malfetti, Executive Officer, Safety Research and Education Project); April 1, 1960-April 1, 1962. Sponsor: Grant from Dept. of Health, Education, and Welfare: National Institutes of Health (RG-7051).

610.1 "Measuring Teacher Effectiveness in Driver Education"—J. L. Malfetti, Dir., Safety Research and Educ. Proj.; and W. G. Anderson, Research Asst.: Safety Research and Educ. Proj., Teachers College, Columbia U. (Box 148, New York 27, N. Y.); April 1, 1960-March 31, 1962. A preliminary report on the determination of critical behaviors should be available by April 61. The complete report, including the measuring instrument, will not be available until April 62.

610.4 "An analysis of Teacher Preparation Programs in Driver Education in Colleges and Universities of the United States"—C. H. Hartman, Asst. Prof. Driver and Safety Educ., Industrial Arts Dept., Ill. State Normal U., Normal, Ill. Doctoral dissertation, Mich. State U., Ann Arbor, Mich. 1960-1961 or 62.

Completed:

010 "Dictionary of Highway Traffic"—The Traffic Institute, Northwestern Univ., 1804 Hinman Ave., Evanston, Ill., W. R. Stebbins, Jr., Proj. Mgr.; J. S. Baker, Director. July 60.

050 "Bibliography on Theory of Traffic Flow and Related Subjects"—(A preliminary draft). Committee on Theory of Traffic Flow, Highway Research Board, 2101 Constitution Ave., Washington 25, D. C.

100 "Procedural Task Factors and Performance Decrement in Automobile Driving"—T. W. Forbes, Hwy. Traffic Safety Ctr., Mich. State U., East Lansing, Mich. Prepared for presentation at the Symposium on Primary Task Factors in Performance Decrement of the Annual Meeting of the American Psychological Ass'n. in Chicago, Ill. on Sept. 6, 1960.

101 "Inventory Speed Responses and Prior Traffic Records as Predictors of Subsequent Traffic Records"—H. W. Case, Institute of Transportation and Traffic Engineering, U. of Calif., Los Angeles, Calif.; and R. G. Stewart, Research Analyst, Oregon Dept. of Motor Vehicles. *HRB Bulletin 240, "Highway Accident Studies,"* presented at the 38th Annual Meeting, Jan. 5-9, 1959 (Washington, D. C.) 60. (HRB: OR-293), pp. 53-56.

101 "An Evaluation of the Road Test Phase and the Driver Licensing Examinations of the Various States"—Center for Safety Educ., NYU, Washington Square, New York 3, N. Y. F. McGlade. Doctoral Dissertation. 1960.

101 "Driver Education and Driving Simulators"—Nat'l. Commission on Safety Educ., Nat'l. Educ. Ass'n., 1201 Sixteenth St., N.W., Wash. 6, D. C. J. H. Fox; ed. by S. A. Abercrombie and N. Key 57-60.

101 "Ignorance of Collision Course as a Factor in Traffic Accidents"—H. L. Ross, Asst. Prof., Dept. of Sociology and Anthropology, NYU, New York 53, N. Y. This article is based in part on experience in Experimental Case Studies of Traffic Accidents conducted at the Traffic Institute of Northwestern U. in a project supported by the U. S. Bureau of Public Roads (CPR 11-5981), National Institutes of Health, U. S. Public Health Service (RG-5359) and the Automotive Safety Foundation. Aug. 60.

121 "Problems of the Older Driver—A Pilot Study"—

W. A. Mann. *MSU Center Letter* (Michigan State U., Hwy. Traffic Safety Ctr., East Lansing, Mich.), Vol. 3, No. 8, p. 3, May 60. *Hwy. Research Abstracts,* Vol. 30, No. 8, p. 14, Sept. 60.

130 "Medical Guide for Physicians in Determining Fitness to Drive a Motor Vehicle"—Comm. on Medical Aspects of Automobile Injuries and Deaths, AMA Reprint from *JAMA,* March 14, 1959, Vol. 169, pp. 1195-1207.

130 "The Medical Aspect of Road Accidents"—Papers prepared for a Symposium held in Salsomaggiore, May 1959. Published by Automobile Club of Italy, Rome. 434 pp. with summaries in English. Book review. *International Road Safety and Traffic Review,* Vol. 8, No. 2, pp. 43-44, Spring 1960. *Hwy. Research Abstracts,* Vol. 30, No. 7, p. 24, July 60.

130 "Physical and Mental Requirements for the Driver's License"—A summary of pertinent laws and regulations of states and other governmental jurisdictions with related professional recommendations. NYU, Ctr. for Safety Educ. 1959. 23 pp. *Hwy. Research Abstracts,* Feb. 60; Vol. 30, No. 2, pp. 21-22.

130 "Final Report Findings and Recommendations Concerning Accidents with Specialized Ground Support Equipment Used by Aviation Shore Establishments" —Drivers Safety Service, Inc., 298 Broadway, New York 7, N. Y. H. J. Sheppard, Dir.; H. L. Henderson, Proj. Dir. 60.

131 "A Comparison of Visual Screening Data from Students of Driver Education and Age Equivalent Licensed Drivers in Five Massachusetts High Schools" —F. N. Ames, P. A. Piscia. O.D. Degree. Sponsor: Mass. Soc. of Optometrists; Mass. Col. of Optometry, 178 Newbury St., Boston. Mar. 60.

131 "Visual Factors and Automobile Driving" — P. L. Anderson, Keystone View Co., Meadville, Pa. 60.

131 "Visual Factors in Postive Driver Testing"—B. F. Payne, Clinical Prof. of Ophthalmology, NYU Medical College; Pres., Pan-American Assn. of Ophthalmology. Sept. 60.

135 "Accident Proneness in Motor-Vehicle Drivers"— D. R. Davis and P. A. Coiley. *Ergonomics* (Ergonomics Research Society, O. G. Edholm, Secy., care of Medical Research Council Laboratories, Holly Hill, London, N. W. 3), Vol. 2, No. 3, pp. 239-246, May 59. *Monthly Summary of Automobile Engineering Literature,* p. 4, July 60. *Hwy. Research Abstracts,* Vol. 30, No. 10, p. 8, Nov. 60.

136 "Driver Behavior Affecting Design, Speed, Capacity Relationships and Accident Patterns on Expressways" —T. W. Forbes, Highway Traffic Safety Ctr., Mich. State U., East Lansing. Prepared for presentation at Mich. Freeway Operations Seminar, Feb. 29—Mar. 2, 60. *Traffic Safety,* (National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.) June 60.

140 "Environmental Conditions and Driving Efficiency" —K. A. Provins. *Ergonomics* (Ergonomics Research Society, O. G. Edholm, Secy., care of Medical Research Council Laboratories, Holly Hill, London, N. W. 3), Vol. 2, No. 1, pp. 97-107, 1958. *Road Abstracts,* Vol. 26, No. 9, p. 213, Sept. 59. *Hwy. Research Abstracts,* Vol. 30, No. 3, p. 8, March 60.

141 "Alcohol, Drivers and Traffic Safety"—A summary of a study of recent investigations into the effect of alcohol on drivers and the relation of alcohol to traffic accidents. R. Andréasson (Motorforarnas, Helnykterhetsforbund, Regeringsgatan 50, Stockholm C, Sweden), June 60.

141 "Experimental Investigation of the New Anti-Intoxicant 'Promill-Ex' to Test Its Effect on the Blood Alcohol Level"—E. Burger. *Zentralblatt für Verkehrs-Medizin* (Gildeverlag Hans-Gebhard Dobler, Postfach 28, Alfeld-Leine, Germany), Vol. 5, No. 1, pp. 23-8, 1959. (In German). *Road Abstracts,* Vol. 27, No. 1, pp. 21-22, Jan. 60. *Hwy. Research Abstracts,* Vol. 30, No. 6, p. 26, June 60.

141 "Effects of Chlorpromazine and Alcohol on Coordination and Judgment"—G. A. Zirkle, P. D. King, O. B. McAtee and R. Van Dyke. *Journal,* American Medical Assn. (535 No. Dearborn St., Chicago 10, Ill.), Vol. 171, No. 11, pp. 1496-9, 1959. *Road Abstracts,* Vol. 27, No. 1, p. 21, Jan. 60. *Hwy. Research Abstracts,* Vol. 30, No. 7, p. 5, July 60.

210 "Correlation of Vehicle Design and Highway Design"—R. A. Haber and D. K. Witheford. Proc., American Society of Civil Engineers (33 West 39th St., New York 18, N. Y.), Vol. 86, No. HW2, Journal of the Highway Division, Paper 2529, pp. 15-35, June 60. *Hwy. Research Abstracts,* Vol. 30, No. 8, pp. 1-2, Sept. 60.

214.7 "A Report on Safety Belts to the California Legislature"—Summary and analysis of Cal. Hwy. Patrol reports and opinions on 54,348 automobile accidents. R. Tourin and J. W. Garrett. Joint study by Calif. Hwy. Patrol and Automotive Crash Injury Research of Cornell U., 316 E. 61st St., New York 21, N. Y. Feb. 60.

214.7 "Safety Belt Effectiveness in Rural California Automobile Accidents"—A comparison of injuries to users and non-users of safety belts. B. Tourin and J. W. Garrett. Joint study by Calif. Hwy. Patrol and Automotive Crash Injury Research of Cornell U., 316 E. 61st St., New York 21, N. Y. Feb. 60.

310 "Suggested Research and Development in Applications of Nuclear Science and Electronics for Quality Control of Highway Construction"—E. S. Preston, Dir., Ohio Dept. of Hwys.; June 30, 59. Reprint from *American Highways,* Oct. 59.

312.2 "Statistical Determination of Effect of Paved Shoulder Width on Traffic Accident Frequency"—R. C. Blensly, Planning Survey Engineer, and J. A. Head, Asst. Traffic Engineer, Oregon State Hwy. Dept. in cooperation with the Hwy. Research Board Committee on Shoulders and Medians. *HRB Bulletin 240, "Highway Accident Studies,"* presented at the 38th Annual Meeting, Jan. 5-9, 1959 (Washington, D. C.) 60. (HRB:OR-293), pp. 1-23.

316.1 "Studies of Roadway Lighting"—Ohio State U. Research Foundation (Columbus 8, Ohio), 23rd Annual Report, 1959, p. 33. *Hwy Research Abstracts,* Vol. 30, No. 6, pp. 10-11, June 60.

316.3 "Studies of Highway and Roadway Signs"—Ohio State U. Research Foundation (Columbus 8, Ohio), 23rd Annual Report, 1959, pp. 33-34. *Hwy. Research Abstracts,* Vol. 30, No. 6, pp. 4-5, June 60.

316.5 "Night Traffic Guidance"—J. T. Fitzpatrick. *Municipal South* (P. O. Box 1225, Charlotte, N. C.), Vol. 7, No. 2, pp. 17-20, Feb. 60. *Hwy. Research Abstracts,* Vol. 30, No. 4, pp. 1-3, April 60.

400 "Traffic Inputs for Simulation on a Digital Computer"—D. L. Gerlough, Institute of Transportation and Traffic Engineering, U. of Calif., Los Angeles Calif. Reprint No. 73; reprinted from *Highway Research Board Proceedings,* Vol. 38; 59.

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Alcohol, Drivers and Traffic Safety

A summary of a Study of Recent Investigations Into the Effect of Alcohol on Drivers and the Relation of Alcohol to Traffic Accidents

by Rune Andréasson

Traffic Accidents

Motoring unfortunately has a black spot—traffic accidents. Over 90,000 persons are killed each year in traffic accidents throughout the world while over 2.5 million are injured more or less seriously.

Statistics of the dead and injured indicate neither the personal tragedy and suffering nor the great loss to the community. Incapacitation, untimely death and disabilities reduce the capacity to work. Traffic accidents and road injuries involve considerable duty for hospitals, police, the courts, insurance companies and other organizations, and cost a great sum, which from the point of view of the national economy can only be considered a loss, especially as it prevents the more advantageous use of economic resources.

Although there are certain weaknesses in the calculations of the economic costs of road accidents—it is not possible to assess the social costs with complete objectivity—the amounts estimated for various countries are so great that it becomes vital to take measures to reduce the number of traffic accidents.

A Swedish investigation in 1958 showed that almost 1,000 persons were killed every year on Swedish roads and 30,000 to 40,000 were injured, of whom 2,000 were more or less disabled. It has been reckoned that one million man-days were lost because of incapacitation, and that by death or disability, some 35,000 man-years had been lost for the future. In addition to these direct production losses there were the indirect economic losses mentioned above which involve various economic resources and labor having to be used to deal with the results of road accidents.

From both social and economic points of view, traffic accidents are especially grave as they most often involve persons in the most productive age-groups. Almost half those killed on Swedish roads in 1957 were between one and 40 years of age, while three quarters of the injured were in the working age-groups between 15 and 64 years of age.

The economic costs of road accidents in Sweden in 1957, according to the investigation, were as follows:

	Swedish Kronor (millions)	£ (millions)	$ (millions)
22,500 lost man-years through 1,000 deaths	380	25.5	73.4
13,000 lost man-years through 2,250 cases of disability	200	13.5	38.6
One million lost man-days through 30,000 cases of injury	60	4.1	11.9
Medical treatment and administrative costs	75	5.1	14.6
150,000 cases of damage to property	170	11.5	32.8
Total	885	59.7	171.3

The economic consequences of traffic accidents in Sweden for one year were thus $170 million[1] in direct or indirect production losses through personal injuries and damage to property.

According to the National Safety Council publication *Accident Facts*, traffic accidents in 1958 cost the United States $5,600 million (£2,000 million).

It is customary to assemble the causes of road accidents in three main groups: roads, vehicles and people.

The influence of alcohol as a cause of accidents involves the human factor. Faulty sight, hearing or other physical defects, fatigue, sickness of various kinds, and

1. Sweden has about 1.2 million cars and a population of 7.5 millions.

influence of various means, which can impair judgement or the senses are naturally included in this category. The increasing density of traffic, the rising number of road accidents and the economic consequences make it even more vital that all known causes of traffic accidents be eradicated.

There cannot be the slightest doubt that a substantial number of road accidents result from drivers being under the influence of alcohol. This has been demonstrated in Sweden as well as other countries, and a certain amount of international cooperation has been established to deal with this question. Two international congresses dealing with alcohol and road safety have been held—in Stockholm in 1950 and in Canada in 1953—and the problem discussed from the scientific angle.

Statistics

One often hears discussions about the number of traffic accidents resulting from drivers being under the influence of alcohol. Statistics from the majority of countries indicate that two to five per cent of all traffic accidents are caused by alcohol. However, one might question whether the official statistics give an accurate picture of the actual situation. All investigations which have been made on users of both alcohol and the roads, show that the actual number of traffic accidents caused through alcohol is considerably higher than that indicated by official statistics.

Statistics from a number of countries attribute the following percentages of road accidents to the effects of alcohol: France 2.8 per cent (1953), Ontario, Canada 1.4 per cent (1952), Finland 7.6 per cent (1953), Belgium 3 per cent (1953), England 0.25 per cent (1955). In Sweden the traffic accidents in which police investigation showed results from the effects of alcohol amount to 3 per cent.

Investigations were undertaken in 1951 concerning the number of drivers under the influence of alcohol. Statistics are set out in the table below for the number of drivers under the influence of alcohol per 100,000 motor vehicles for certain larger cities of the world.

The table shows considerable variations in the number of drivers under the influence of alcohol per 100,000 motor vehicles. To a large degree this can be explained by the different concepts and definitions of the term "under the influence of alcohol" in different countries and cities. Police methods for determining the amount of alcohol vary, and this also applies to how the number of drivers under the influence of alcohol involved in road accidents are reckoned in official statistics.

The World City Traffic table is of limited value for comparisons as the various statistics have been compiled on apparently different bases. Particular countries and cities are alert to the problem and try through effective police supervision and stringent regulations to take action against the danger of the drunken driver, while elsewhere a more lax attitude prevails and it is hardly acknowledged that the drunken driver is a menace to road safety. Despite the lack of standardized definitions one can conclude from official statistics that a by no means insignificant proportion of road accidents are caused by drivers under the influence of alcohol.

If one looks into the extent of the injuries from road accidents caused by drivers under the influence of alcohol, one discovers that the number involving death is many times greater than indicated by the official statistics covering all traffic accidents.

NUMBER OF DRIVERS UNDER THE INFLUENCE OF ALCOHOL IN CERTAIN WORLD CITIES, 1951

City	Inhabitants	Motor Vehicles		Drivers under the influence of alcohol	
		No.	per 1,000 inhabitants	No.	per 100,000 motor vehicles
New York	7,835,099	1,412,722	180	289	20
Paris	4,775,711	431,922	90	199	46
Los Angeles	2,084,970	974,285	476	7,919	813
Rome	1,696,642	201,000	118	18	9
Hamburg	1,658,038	71,097	43	1,855	2,600
Birmingham	1,117,900	104,226	93	101	97
Naples	1,000,500	60,000	60	3	5
Singapore	1,000,000	38,011	38	8	21
Copenhagen	883,893	48,319	55	544	1,126
Amsterdam	850,676	40,953	59	535	1,071
Washington	802,178	235,089	293	149	63
Lisbon	783,919	29,648	38	7	24
Stockholm	752,193	60,463	80	589	974
Marseille	642,000	90,500	141	4	4
Oslo	439,000	30,519	70	159	521
Zürich	396,379	33,069	83	255	771
Helsingfors	375,981	16,217	43	297	1,831

Source: World City Traffic, 1951

Dr. Sven Rogind undertook an analysis of road accidents in Denmark covering the 23,383 accidents which happened in 1956. Alcohol was the main cause in 4.9 per cent of the cases. Where the accidents involved injury or death, alcohol was the cause in 8.2 per cent of the cases and an investigation of road accidents in which death resulted showed that 15.3 per cent involved alcohol.

The Mossberg Report of the 1953 Swedish Commission on Road Safety (1953 ars trafiksakerhetsutredning) gave a detailed analysis of all Swedish traffic accidents which occurred in 1952. In 3.2 per cent of all the motor accidents, the drivers were under the influence of alcohol.

In 43 cases, or six per cent of cases involving deaths, drivers were under the influence of alcohol. The percentage of accidents with drunken drivers was thus twice as great in cases involving death as in total accidents.

The comparison between accidents resulting from drunken driving and other accidents, in regards to negligence, showed that 96 per cent of the accidents involving alcohol led to convictions for traffic negligence, while this was the case in only 43 per cent of other road accidents resulting in death.

As has already been stated, the Mossberg Report attributed to alcohol six per cent of all accidents involving death in 1952. However, if one assembles all accidents resulting in death and which involved convictions for traffic negligence into a single group, one discovers that 12.5 per cent of these accidents are the results of drunken driving.

In the investigation of personal injuries treated in Scandinavian countries, undertaken by the Association of Scandinavian Surgeons (Nordisk Kirurgisk Forening), there was an analysis by Sven Wahlgren of 222 Swedish

road deaths which had taken place in 1956. From this analysis one could discover that of 222 deaths, alcohol had been the chief cause in 36 cases, that is, in about 16 per cent of all cases. Another seven involved alcohol to some extent; this made a total of 19.4 per cent of all cases of death involving alcohol to a greater or lesser extent. In the medical statistical part of the investigation, it was shown that of the cited 19.4 per cent of the cases where alcohol was involved, 5 per cent of the dead had consumed excessive quantities of alcohol.

An analysis of traffic accidents in 1956 in West Germany shows that 45,000 among 904,000 accidents were caused by drivers under the influence of alcohol, i.e., 5 per cent. But in 18.9 per cent of the accidents resulting in death, alcohol had been the chief cause.

It is thus worthwhile in this respect, to study the annual statistics of traffic accidents published by the National Safety Council, in America, for instance "Accident Facts 1955," the influence of alcohol in motor accidents in the State of Maryland, 1953, and "Accident Facts 1956," an analysis of traffic accidents in the State of Delaware in 1955.

The table below shows the investigations which have been carried out in various countries as to the part alcohol plays in road accidents in which persons are killed.

SOME INVESTIGATIONS SINCE 1946 INTO THE NUMBER OF ROAD ACCIDENTS INVOLVING ALCOHOL AND RESULTING IN DEATH, EXPRESSED AS A PERCENTAGE OF ALL ROAD ACCIDENTS

Author	Year	Per Cent	Country
E. Sjovall	1946	29	Sweden
H. Sjovall	1949	25.5	Sweden
Gyongyossi	1950	38	Hungary
Domenici	1951	40	Italy
van Hecke	1951	40	The Netherlands
Spain, Bradess, Eggston	1951	46	U.S.A.
Jungmichel	1952	24	W. Germany
Zanaldi	1954	44	Italy
Vámosi	1955	39	Czechoslovakia

Sources: Elbel, Vámosi and others.

G. O. Jeffcoate at the Road Research Laboratory in England, examined police reports for three police districts in order to determine the presence of alcohol in road accidents resulting in death. It was established that one or more persons had consumed alcohol in at least 50 per cent of the accidents where death was involved, which took place after 10 p.m., and in 10-25 per cent of all other road accidents resulting in death.

In Stockholm, J. Hindmarsh and B. Linde made an extensive investigation during 1932-1933 to determine the amount of alcohol in the blood of persons involved in traffic accidents without fatal consequences. Over a period of a year, blood tests were systematically taken of persons who had to be taken to a hospital for treatment of the injuries suffered in traffic accidents. One hundred and thirteen casualties were examined and in no less than 44 per cent of the cases had alcohol been consumed; and in 58 per cent of the cases, i.e. 29 per cent of the total, there was more than .10 per cent alcohol in the blood.

Bjerver, Goldberg and Linde undertook an investigation between October, 1951 and March, 1952 of all male casualties from accidents arriving at Stockholm casualty wards. Blood tests were taken on arrival, day or night. During this period 663 casualties were examined. Of this number, 71 had been injured in traffic accidents and 32 per cent of these casualties had consumed alcohol.

The findings of these investigations are greater than the numbers given in official statistics of road accidents involving alcohol.

The most pronounced reasons why official statistics provided by most countries are so unreliable come under three main headings:

1. Only accidents which come to the attention of the police are reported in official statistics and by no means all accidents are reported. This is well illustrated in Sweden when, in 1958, some 56,600 accidents came to the notice of the police while 171,000 cases of damage or injury on the roads came to the notice of the insurance companies. It is evident that a motorist who has been drinking and who has been involved in a traffic accident is quite anxious that the matter does not come to the attention of the police, as the legal consequences can be serious, involving automatic suspension of the driving privilege. It must be suspected that a driver, who has caused an accident while under the influence of alcohol, is often very ready to compensate, off the record, for the damage caused.

2. The investigation of a road accident occurs quite some time after the accident has taken place and it cannot always be definitely proved that alcohol was a direct or contributory cause. It is then natural to fall back on the driver's own statement or the accounts of witnesses.

3. Official statistics do not show causes where the alcohol content of the blood has been sufficient that it could well have been a cause of the traffic accident, but at the same time so low that it did not appear obvious and thus was not detected by police or witnesses.

Naturally it is very difficult to fully describe the part alcohol plays as the cause of road accidents. The Mossberg Report points out that present statistics accept, as a basis, that the accident risk rises only when the alcohol content of the blood is relatively high. However, recent investigations show that danger is considerable even where there is a small amount of alcohol in the blood, thus the basic conclusions of earlier investigations must therefore be revised.

Even if official statistics do not give a correct picture of the influence of alcohol as a cause of road accidents, there is no cause for complacency even on those figures.

Dr. Milan Vámosi, of Komensky University at Bratislava in Czechoslovakia, is responsible for the most recently published report* of the great danger facing an intoxicated driver. In 1958, Dr. Vámosi examined all motorists during a given time in a certain street and tested their sobriety. If the preliminary alcohol test was positive, a blood test was made to determine the alcohol content of the blood. The findings of his examinations show that with .03 to .099 per cent, the risk of accident for a drinking driver is seven times greater than for a sober one; between .10 and .149 per cent the risk is 31 times greater and over .15 per cent, the driver who has been drinking runs a 128

Research Review, Sept., 1960, pp. 8-11.

times greater risk of being involved in an accident, than a sober motorist.

Insurance Statistics

Abstaining drivers are currently being considered for quite an attractive insurance proposition now that the part alcohol plays in the frequency of traffic accidents is becoming known. All Swedish insurance companies now offer special motor insurance premiums to teetotalers. Of special interest in this matter is the development of insurance companies for drivers who are non-drinkers. In several countries, special insurance companies which insure only abstaining drivers are working (e.g., Ansvar, Sweden; Preferred Risk Mutual Insurance Company, U.S.A.; Ansvar Insurance Agency Ltd., England; Varde and Ansvar, Norway and A-forsikkring, Denmark).

Ansvar (previously Motorförarna[2]), the Swedish insurance company for abstaining drivers, was formed in 1932; and it is of interest to study the company's statistics because, in the main, the company is chiefly concerned in actual practice with *claims for damage*. Damages to the insured's own vehicle are not counted in the figures presented. A study showed that the average frequency of damage for the period 1933 to 1946, within the various insurance policy categories, was between 21 and 47 per cent lower for Ansvar than for other Swedish insurance companies. For the majority of the years, the difference was between 30 and 40 per cent. Over the 14 years covered by this statistical study, Ansvar had an average of 7,156 claims for damage per 100 insured vehicles, compared with an average figure of 11,373 for the other Swedish insurance companies.

Since 1947, the differences have been less. After adjustments have been made concerning classes of risk and ages of the insured, one finds that temperance drivers insured by Ansvar were involved in 25 per cent fewer claims for damage in 1949, and 30 per cent in 1950, than drivers insured by other Swedish insurance companies.

From 1950 to 1955, a more detailed comparison can be made and it is possible to make comparisons between damage cases with Ansvar and with certain other individual Swedish insurance companies. By this means it is possible to obtain more thorough information about the temperance drivers as an insurance risk, as the general structure of the various Swedish insurance companies is well known.

Statistics of private cars throughout Sweden with the exception of the largest cities, which constitute the greatest risk groups, show that there is an average of 15 to 20 fewer claims for damage every year with Ansvar than with the other Swedish insurance companies. Comparisons between individual insurance companies show that these companies differ widely among themselves as to accident level and show considerable disparity.

Ansvar has approximately 20 per cent fewer claims for damage than other insurance companies with fixed rates, i.e., those companies which do not differentiate between applicants, and work on the same premiums. The difference shrinks to between five and 10 per cent when a comparison is made with insurance companies which for various reasons differentiate between applicants.

2. In Swedish, Ansvar means responsibility, and Motorförarna can be translated as The Motorists'.

FREQUENCY OF CLAIMS FOR DAMAGE PER 100 VEHICLES

Year	Damage Claim Freq. w/Ansvar	All Other Swedish Insurance Companies	Non-Schedule 1	Non-Schedule 2	Schedule 1	Schedule 2
1951	4.12	6.61	5.62	5.44	6.41	7.11
1952	4.55	5.18	4.64	4.39	5.08	5.53
1953	3.40	4.33	3.47	3.82	4.16	4.71
1954	3.81	4.73	3.91	3.76	4.76	4.45
1955	4.00	5.31	4.74	4.43	4.98	5.22

Ansvar points out that this is due to the fact that in certain companies there are large groups of insured persons who would almost meet Ansvar insurance requirements. The responsible behavior of the teetotaler has been established in various connections. Most noticeable is his sense of responsibility, care and economic sense, which are greater than with the general public as a whole. Of course, these characteristics are also found in other bodies, such as religious and social groups and with certain professional men. To the extent that such persons are insured with other insurance companies, the accident frequency is likely to be reduced accordingly.

Deterioration of Bodily Functions

Numerous experimental investigations have been carried out on the roads and in laboratories in order to determine the amount of alcohol in the blood at which it can be established that a deterioration of functions has resulted which will affect driving skill.

Speaking generally, one can say that the more complicated the given task is, the smaller the amount of alcohol necessary to prevent its accomplishment. To a large extent in the experiments, such methods have been used to determine the influence of alcohol on the various organic and psychological functions while excluding the effects of, for example, fatigue, lack of practice, illness and the like. It has been established that alcohol has an effect on the sight, hearing, powers of concentration and reaction and also the co-ordination of the muscles, but the amount of alcohol causing these effects can vary from person to person.

Laboratory experiments have the weakness of not being directly comparable with traffic conditions. However, this does not exclude one from drawing certain practical conclusions from research, as laboratory experiments can be conducted with essentially strict methods and using special material, which make exact measurements possible.

Some of the findings of recent investigations, as to the effects of alcohol on the human body, are given briefly below and they show that even after drinking small quantities of alcohol, certain functions are affected, and the most significant of these is driving. Even if certain parts of the experiment might be criticized, the investigations demonstrate that the heart of the matter is that quite small amounts of alcohol can jeopardize road safety.

A common finding in the laboratory experiments is that deterioration of functions such as driving, occurs even though the amount of alcohol in the blood is not sufficient to give outward signs.

Many laboratory experiments have been made which are directly comparable to driving in traffic. For example: in

1932, Graf, at the Dortmund Institute of Labor Psychology, used an apparatus with which one could track for about 10 minutes the course steered by a person at a steering wheel. Driving skill was tested in four different respects: average speed, deviations from the traffic lane ("driving towards the ditch"), the time it took to return to the correct traffic lane, and the number of times the brakes were used. With .05 per cent alcohol in the blood, there was a tendency to "drive towards the ditch" in 82 per cent of the cases, on the average. With more than .10 per cent alcohol in the blood, all the functions tested proved to be deteriorated.

The conclusion of these findings, is that drivers under the influence of alcohol show tendencies to get involved in difficult traffic situations and their ability to cope with these situations is definitely reduced. Professor Drew adds, "Taking the group as a whole, there is, on the average, a measurable deterioration in performance when there is in the blood the smallest quantity of alcohol that can be detected by existing instruments."

Swedish research workers carried out an extensive investigation during 1947-1948 in which various types of driving tests were given (Goldberg 1948; Bjerver and Goldberg 1950).

The purpose of this investigation was to determine:

(1) the effect of small amounts of alcohol: 100-130 c.c. of schnapps, or 1-1.33 litres of beer.

(2) the action of the alcohol in relation to the effect of practice, nervousness, and tiredness.

(3) the difference in skill before and after drinking alcohol, with persons of different degrees of driving skill.

(4) the effect of drinking alcohol in actual driving in comparison with the effect on the same driver in laboratory tests.

A closer analysis of the material shows that the point at which deterioration sets in is at .035 to .04 per cent alcohol in the blood. At this point the driving of half the drinkers showed a deterioration in comparison with drivers of a similar degree of driving ability, used to alcohol, but who had not drunk any on this occasion. The actual point varied widely and there were drivers in this test who showed a definite deterioration even with as low as .02 to .03 per cent alcohol in the blood.

The most important finding of this investigation is that a determinable reduction of driving ability can be established with an average of .05 per cent alcohol in the blood, and that deterioration begins below this point, on the average, between .035 to .04 per cent. With these amounts, only in a very few cases were signs of intoxication noticeable to the eye.

In order to obtain further data, to determine the relationship between alcohol and effects on driving ability, a new and extensive series of practical driving tests were undertaken in the spring and summer of 1952 (Bjerver and Goldberg).

A compilation of the findings of this investigation completely confirms the findings of the previous one. A definite deterioration in driving ability was established at .05 per cent alcohol in the blood, with an increase in the number of faults, greater carelessness, more frequent stalling of the engine at a crucial moment, reduced precision in steering and braking, and general deterioration of driving. Below this point, deterioration begins for most drivers after drinking at an average of .03 to .04 per cent alcohol in the blood, which, on the question of the familiarity with driving, driving ability and use of alcohol, must be considered as representative of Swedish motorists.

It is interesting to note here that the findings of these scientific experiments show a tolerance limit for drivers who have been drinking, which is, in effect, considerably lower than that which one had reason to believe previously. Drew says, in his report, that he could not prove any specific threshold concentration where the influence of alcohol constitutes a danger when driving. He established that driving ability deteriorated as soon as the alcohol content of the blood became measurable; and this level is extremely low.

A group in the University of Manchester department of psychology, has undertaken a study of bus drivers. Three research workers: Cohen, Dearnaley and Hansel, made a study of the driver's power of judgment. They started with the actual skill of the driver in relation to what he thinks himself capable of accomplishing, and what he does because of this is decisive in the event of an accident. This theory is interesting mainly as the opinion is often voiced that it is not proved that a motorist drives worse after drinking. Many mean that knowing that he has been drinking and consequently that his driving skill has been impaired, such a driver will deliberately compensate for this by driving with greater care and vigilance and at a slower speed.

In summing up the experiment, the three research workers say that they do not think it is justifiable, on the basis of their experiment, to establish the interval of .00-.05 per cent as safe. They add, "We have found that the reliability of a man's judgment of his driving skill was impaired even after a small quantity of alcohol producing a blood alcohol concentration lower than .05 per cent. This impairment of judgment occurred in what might be described as the *elite* driver. Furthermore, the effects of the alcohol were in a sense minimal, as the alcohol was taken immediately after a meal. The drivers' performance deteriorated, they were involved in greater hazards, and they displayed a false confidence in their driving abilities.

"Ordinarily, a driver suspected of being under the influence of alcohol, cannot be given a test of safe driving. We suggest, therefore, that measures taken to reduce traffic accidents due to alcohol must forbid the taking of alcohol for some specified period before driving. The menace to public safety comes particularly from those who, after a slight amount of alcohol, feel they are sober or believe are driving more cautiously."

Determining the Influence of Alcohol

Sweden has taken up the matter of the most suitable means of determining the influence of alcohol. The question has been put whether medical examination, i.e., an observation of behavior, appearance, speech, etc., shows the influence of alcohol, is to be preferred to the blood test method.

It is very difficult to determine by medical examination whether a person was in a fit condition to drive a motor vehicle, at least at the lower extent of the influence, and the accounts of witnesses of the manner of

driving and the amount of alcohol drunk are often hard to judge.

In Norway, Professor Jakob Molland (1954) made a study of 4,000 medical reports over a three year period. At the same time, blood tests were taken and it was shown that in only 33 per cent of the cases of persons who had .05 per cent alcohol in the blood, could the influence of alcohol be observed in the medical examination. This meant that in two thirds of the cases, the influence of alcohol did not show in outward signs, and could not be established by medical examination. Somewhat more than half, or 58 per cent to be exact, of those who had .10 per cent alcohol in the blood were declared at the medical examination to be under the influence of alcohol, and only 76 per cent, or just over three quarters of them, who had as high as .15 per cent alcohol in the blood were medically certified as being under the influence of alcohol. Not until .30 per cent was reached were all so certified as being under the influence of alcohol.

The following table from the Report of the 1949 Swedish Commission on Alcohol and Road Safety (1949 års Trafiknykterhetsutredning) shows the relation between the alcohol content of the blood and the number of cases detected by medical examination.

Relations Between Alcohol Content of the Blood and Number of Cases Certified as "Being Under the Influence of Alcohol"

(Expressed as a percentage of the number examined) 700 cases divided between seven doctors.

% Alcohol In The Blood	Doctor							Average No.
	I	II	III	IV	V	VI	VII	
.000-.05	—	25	0	50	0	0	25	14
.051-.10	100	50	78	50	60	0	25	53
.101-.15	91	72	77	86	57	63	43	70
.151-.20	100	97	100	94	83	69	77	88
.201-.25	100	100	100	93	100	79	95	95
.251-.30	100	100	100	86	100	100	90	96
Over .30 ..	100	100	100	100	100	100	100	100

Source: Swedish Official Report SOU 1953: 20 Table 35, Stockholm, adapted from Liljestrand 1940).

Blood Tests

It is naturally of the greatest importance that methods which are both accurate and practical be used in the analysis of the blood sample for the determination of the alcohol concentration. In general, one uses the Widmark Method.

Many experiments have been made to check the reliability of the Widmark Method. At the request of the Swedish Home Office, the Swedish Ombudsman, responsible for legal matters, made an investigation of certain questions concerning the activity of the Official Laboratory of Forensic Medicine and questions arising from it. A report entitled *Alkoholprovet (The Alcohol Test)*, was published in October 1956. The Ombudsman, mindful of the reliability of the Widmark Method, which had been sanctioned by the 1949 Committee on Alcohol and Road Safety, but afterwards subject to discussion, took up the question of changes in the alcohol content of the blood sample. After examination, the investigator had declared that there was no cause to question the reliability of the Widmark method, and pointed out that it was a very good method for determining alcohol concentration.

In January 1955, the joint Scandinavian Parliamentary Committee on Road Safety Matters, which has been in operation for several years, sent blood samples for analysis to the institutes of forensic medicine in Stockholm, Copenhagen and Oslo. The analyses were according to the table with no greater differences than those within the statistical margin of error.

	Copenhagen	Oslo	Stockholm
Blood sample A.....	.087%	.086%	.087%
Blood sample B.....	.140%	.139%	.141%
Blood sample C.....	.186%	.183%	.188%

Sweden had, up to the summer of 1955, reckoned the margin of error as .015 per cent, which is three times the average error accepted in previous experiments to be .005 per cent. Later research shows that the average error is less. Now it is .013 per cent if three capillary tubes are analyzed by each method. If only two capillary tubes are analyzed by each method, the average error is reckoned at .016 per cent. For ordinary comparison, three capillary tubes are analyzed by the Widmark Method, and two by a second method, and the figure is .014 per cent. This figure is not given as final, but is subject to change. Certain deductions are made from the figure given in the analyses, in order that the *minimum* alcohol concentration in the blood can be established for forensic medical purposes.

Sweden, as has been stated above, in the main, uses the Widmark Method for analyses of blood samples for the determination of alcohol. However, Professors Bonnischsen and Theorell have developed a new method which is known as A.D.H. This provides for determination of the alcohol content of the blood by a method of analysis which is specific for alcohol. The presence of other substances—ether, methyl alcohol, acetone, etc.—which can influence the result of the Widmark Method, have no effect with A.D.H.

Sweden now uses A.D.H., in addition to the Widmark Method, in order to determine the amount of alcohol in the blood, and so there is a double-check of the analysis results. Experiments which have been made show that there is very good agreement between the two methods.

Alcohol in the Breath

There is also the possibility of establishing the presence of alcohol in the blood by taking a sample of the breath and analyzing it, and this method is very well known and used in most states in the U.S.A. The most widely known apparatus for doing this is the American device—designed by Professor Harger of Indianapolis, Indiana — the "Drunkometer."

Many devices of this type have appeared, but of simpler design, including that of Jetter and Forrester (1941)—

the "Intoximeter." Swedish police are now equipped with "Alcotest," which is of German origin.

These very simple devices for establishing the presence of alcohol, are very good items of police equipment, as they can establish, on the spot, whether their suspicions of driving under the influence of drink are justified or not. In many countries the breath test is also used as proof of the presence of alcohol.

The question has been asked, "Can there be alcohol in the blood stream not caused by drinking?" Swedish groups carried out several tests, which have been presented with, or given, great publicity when they took place. From these it was concluded that diabetics, under certain circumstances, could have alcohol in the body, without consuming alcoholic drink. Further investigation, however, showed that the method in these tests was not completely reliable.

The 1949 Swedish Commission on Driving and Road Safety (1949 års Trafiknykterhetsutredning), stated its report that the misleading results of these tests had been caused by the difficulties of getting chemicals which were pure enough for analytical purposes during the war years and the immediate post-war period. Later tests showed that diabetics had no greater amount of alcohol or other reducing substances which can simulate alcohol. Thus, it follows that normally there is no alcohol in the blood of diabetics unless they consume alcohol. Their bodies treat alcohol in the same way as normal bodies, and there is no reason for diabetics to be put in a separate category from the legal viewpoint if they are involved in traffic causes where alcohol is suspected.

The idea also exists that fruit, fresh bread or other foodstuffs can increase the amount of alcohol in the blood. Extensive research has been carried out to study the effect of fruit such as apples, oranges, gooseberries, grapes and bananas. Even with the consumption of large quantities of fruit, no increase above the normal level has been shown scientifically. It must be considered a fact that there can be no alcohol in the body without alcohol first being drunk.

Sobriety Preparations

Sobriety preparations are also worthy of attention. From time to time, patent medicines appear on the market which are claimed to have a favorable effect on the action of alcohol and accelerate combustion or prevent the absorption of alcohol in the system. Experimental tests indicate that these medicines have no effect.

Also ineffective are all household remedies against the effects of alcohol. Even after physical jerks, running, hot baths or sleep, alcohol and its effects still remain.

Coffee is widely believed to lessen the alcohol content of the blood, but Professor Ponsold claims that this is not the case. It is true that coffee and other stimulants can cause certain feelings of fatigue to disappear, but alcohol and its effects on the body remains.

One often hears that Coca-Cola can also counter the effects of alcohol. In the work cited above, it is mentioned that this drink can have the same effect as coffee, as four bottles of it have the same caffeine as a cup of coffee. Coffee can prevent tiredness, but alcohol and its effects remain.

In this connection, it is worth mentioning that many medicines can increase the effects of alcohol. This is so in the case of a number of sleeping tablets and slimming preparations. Recent German investigations have proved that nicotine too, intensifies the effect of alcohol. Professor Lickint has established that this connection which is very understandable, as nicotine becomes a further poison in the system of the drinker.

Legislation

Many countries have passed special road sobriety legislation in the fight against drunken driving. Despite considerable variations from country to country in this kind of legislation, it can be concluded that this type of legislation has a general preventive effect.

Scandinavia has pioneered such legislation since Denmark, in 1903, passed the first law against driving under the influence of alcohol. However, modern legislation in this sphere was introduced in the twenties and revised recently by Denmark, Finland, Iceland, Norway and Sweden.

The law which is now in force in *Denmark*, was passed in March 1955. Paragraph 16, clause 1, states, "that a vehicle may not be driven or attempted to be driven by a person who has consumed alcohol to such an extent as to be unable to drive the vehicle in a safe manner."

Denmark thus has no legislation determining the amount of alcohol in the blood, yet the blood test is admissible in evidence. Paragraph 16, clause 4 of the Traffic Code, states explicitly that the police can take anybody suspected of drunken driving to a doctor for examination and to obtain samples of the blood and urine, in order to determine the alcohol concentration.

The punishment for driving under the influence of alcohol in Denmark is imprisonment for twelve months, or a fine if there are extenuating circumstances.

The existing Finnish legislation came about in 1957 and, according to Paragraph 8, a person who is drunk, or under the influence of alcohol or other intoxicant, is to be sentenced to imprisonment or penal servitude, for up to three years. In extenuating circumstances, a fine can be imposed. When anyone has been killed, the punishment can be up to eight years penal servitude. The driving license is automatically withdrawn and the court determines if and when a new driving license can be given.

Iceland introduced new traffic laws in May, 1958. Paragraph 25 covers the matter of alcohol concentration in the blood. It states that no one may drive, or attempt to drive, a motor vehicle if, because of consuming alcohol, he can be considered incapable of doing so intelligently if there is between .05 and .12 per cent alcohol in the blood, or if the driver is obviously under the influence of alcohol, even though the alcohol concentration in the blood is less than .05 per cent, he shall be considered incapable of driving a vehicle in a safe manner. When there is over .12 per cent alcohol in the blood, the driver shall be considered totally incapable of driving a vehicle.

It is necessary to submit to blood and urine tests and other examination a doctor can require.

Norway introduced new road sobriety legislation in 1959 and maintained unchanged the punishable amount of alcohol at .05 per cent, which has applied since 1936. The law states that no one may drive, or attempt to drive, a motor vehicle when he is under the influence of alcohol or any intoxicants or drugs. Should he have more than

.05 per cent alcohol in the blood, or an amount of alcohol in the body which can result in such an alcohol concentration, he shall be considered to be under the influence of alcohol. The punishment is imprisonment and the suspension of the driving license for at least one year.

The law requires that drivers of motor vehicles who have been involved in a road accident, shall not partake alcohol or any intoxicants or drugs for six hours afterwards. However, this no longer applies if the police have a doctor to take a blood sample, or decide that a blood test need not be taken.

Norway also has a law, passed in 1936, requiring persons in certain positions to abstain from alcohol in certain circumstances. This applies to the military, to active railway workers, to tram-drivers, etc. These persons must not drink alcoholic beverages, with the exception of beer having an alcohol content of 2.5 per cent or less, while on duty and also eight hours after duty commences, and in the case of certain military personnel, also for a time after their duty has been completed.

Sweden is now conducting a new inquiry into the question of road sobriety, and it can be expected that Swedish laws on the subject will be revised within the coming years. At present, offenses are divided into two categories, serious offenses and less serious ones. The law states that the driver of a motor vehicle who is under the influence of alcohol or other intoxicants, so that it can be considered that he cannot drive in a safe manner, shall be sentenced for drunken driving to be at least twelve months imprisonment, or fined if there are extenuating circumstances. If it is judged as a serious offense, the punishment shall be imprisonment or penal servitude. Should a motorist have .15 per cent alcohol in the blood, he shall be considered to be under the influence of alcohol and the case be judged as a serious offense.

If it cannot be shown that the driver of a motor vehicle is under the influence of alcohol to the extent stated above, but has at least 0.5 but not .15 per cent alcohol in the blood, punishment can take the form of either imprisonment or a fine.

Suspension of the driving license shall take place for all offenses, for a period of one to five years.

Summing up Scandinavian traffic laws, it can be said that they are strict and are considered to have a general preventive effect. Blood tests are recognized as legal evidence in Denmark, Iceland, Norway and Sweden, and are used in Finland.

Iceland, Norway and Sweden set the punishable level at .05 per cent alcohol in the blood, while Denmark and Finland have no legislation concerning alcohol concentration in the blood.

Checks On Driving Licenses

Careful investigation of sobriety in connection with the issue of driving licenses, and, as has been previously mentioned, fresh tests for driving licenses after suspension, effective traffic supervision, and also information and publicity services are important measures against drunken driving.

It cannot be too strongly emphasized that it is important to eliminate at an early stage persons who are not of sober habits from the possibility of their obtaining driving licenses. This control can be carried out with reasonable accuracy, but tests should be introduced at an early stage, such as when a person applies for a provisional driving license or its equivalent. With modern test methods, it should not be impossible to eliminate well in advance, persons who would be potentially dangerous drivers.

Rational and up-to-date treatment of the alcoholic is important for road safety, as alcohol is frequently misused to a considerable extent by drunken drivers. It is a matter of some urgency that these people be treated and also prevented from driving.

Many countries have provision for an obligatory re-test for driving licenses after the period of suspension. Such conditions generally make an effective contribution to reducing the number of traffic accidents. In Sweden and other countries a driving license can be an essential, and this has presented the authorities and doctors with problems on many occasions. Initial symptoms of certain illnesses can make it undesirable for the sufferer to drive, or in any case make him an increased traffic risk. A person who is believed to be diligent and sober, can yield to alcohol and perhaps succumb to its influence, yet if this does not come to the notice of the authorities, it will be impossible to withdraw his driving license.

Fresh tests for driving licenses, which will also take into account the applicant's health and sobriety, as well as his driving ability, would make an active contribution towards preventing drunken driving and help to increase road safety.

A Final Word

Extensive scientific research has shown that physiological and psychological functions of the most varied character —and of importance to road safety—are adversely affected by alcohol. The amount of alcohol drunk need not be in any way great, in order that driving ability be lessened. It has been proved that less than .05 per cent alcohol in the blood is dangerous for driving. Investigations into the effects of the influence of alcohol, establish that there is increased risk even with very little alcohol in the blood.

It is necessary to impress motorists that absolute sobriety is necessary when driving, and thus create a definite morality standard for motorists. Thus, there is a demand for the findings of scientific research on this subject to be extensively publicized, so that all motorists will accept the condition of complete sobriety on the road. The requirement of no alcohol while driving could possibly be brought about by law. Swedish public opinion believes that strict legislation on this matter helps to prevent drunken driving.

However, it cannot be ignored that a great many people are under the impression that a violation of the road sobriety law occurs only when an accident results. This belief is detrimental to other road safety regulations. Road safety always demands a safety margin, for example: two braking systems are required even though only one is really essential.

A motorist in good condition can usually provide his own safety margin. On the road, he does not use his entire driving ability the whole time, but has a reserve to meet the unexpected situation necessitating presence of mind. The driver who has spent this reserve of driving ability by drink, has not the quick presence of mind to avoid an accident in an unexpected situation. Traffic everywhere is becoming denser and demands all the more from the motorist; unexpected situations arise all too often. Abstinence from alcohol, both before and while actually driving, is now an absolute essential for road safety.

Awareness of Collision Course in Traffic Accidents

by H. Laurence Ross

In the analysis of accidents, with the goal of their prevention, a central problem is the identification of a common factor that appears in a significant proportion of accidents. Experience in the Northwestern University project, "Experimental Case Studies of Traffic Accidents," suggests that such a factor may be found in the lack of awareness of collision course. In a two-vehicle collision, one or both drivers may not realize the presence of the other vehicle until it is too late for effective evasive action, or, if the other vehicle is perceived in time, its course may be incorrectly predicted.

This report uses data from the 48 accidents studied by the Case Studies project to exemplify and detail the problems presented by these conditions to drivers. It suggests ways in which these conditions can be improved in order to reduce collision accidents.

The Driving Task[1]

The function of driving is to move people and goods from an origin to a destination. An accident represents a failure in this task. While accidents are of many varieties, the most common type, and the exclusive concern of this paper, is collision between vehicles. Such accidents are the results of collision course, which can be defined as a dynamic situation in which two objects will collide if the direction and acceleration of both remain unchanged. Objects are on a collision course if the distance between them is diminishing and the angle between the path of either and a line drawn from one to the other is constant.

Collision accidents can be avoided if a collision course is recognized early enough in relation to speed by one or both drivers and action is taken to change the direction or acceleration of one or both vehicles. This action is termed evasive action, and constitutes the crucial aspect of the driving task. It consists of the driver's perception and prediction of the course of the other vehicle, followed by decision upon and execution of a plan of action that will end the collision course.[2] This must all be accomplished before the point in the driver's path, termed the point of no escape, at which action cannot be effective because there is insufficient time and space in which to perform it. Thus, an additional aspect of the driver's task is the regulation of his speed and position on the road, depending on the probability of a collision course developing, in order to give adequate time for evasive action. Such regulation is termed "tactics." It sets the stage for evasive action.

This article is based in part on experience in Experimental Case Studies of Traffic Accidents conducted at the Traffic Institute of Northwestern University in a project supported by the U. S. Bureau of Public Roads (CPR 11-5981), National Institutes of Health, U. S. Public Health Service (RG-5359), and the Automotive Safety Foundation. Footnotes refer to chapters in the final report of the project, which is available on request from the Northwestern University Traffic Institute.

Delayed Perception

In taking successful evasive action in a collision course, the driver must perceive and predict the course of the other vehicle. Adequate perception is a prerequisite for correct prediction. A delay of perception beyond the point of no escape will result in a continuance of the collision course, and an eventual accident. This condition was a common one in the accidents studied. In the accident histories, the presence of delayed perception was often stated by drivers in their interviews, in a manner such as, "I didn't see him until he hit me." In other cases, delayed perception was ascribed by the research team as a factor in the accident because conditions were observed at the scene of the accident or in the report of the participants that appeared likely to have contributed to the accident through interfering with perception.

Delayed perception appears to have two major causes. In one case, termed "impediments to vision," a driver's view of another vehicle is obstructed in some fashion so that the other vehicle is not visible during a segment of the driver's course. In the other case, termed inattentiveness, the other vehicle is visible, but the driver is attending to a different aspect of the situation and is not conscious of the other vehicle.

Impediments to vision appear to be of many kinds. An often cited example is poor visual equipment of the individual. Other types of impediments to vision are located within the vehicle, as design blind spots or passengers in the front seat. Still others can be located in the wider environment, exemplified by parked cars, trees, and buildings near intersections.

Inattentiveness likewise can be subdivided. In some cases, habits of scanning the environment are involved. In other cases, items in the vehicle, such as gauges, passengers, and the like, may be cited. The driver can be distracted "by his own thoughts," in daydreaming. Most commonly, items in the environment, either because they are unusual and attractive, or potentially hazardous, result in distraction from the collision object.

The following list gives examples of situations in the accident histories in which it is believed that delayed perception was a major factor. The numbers of the accidents in which a given condition is believed to have been present are listed at the end of each section.[3]

Incidents of Delayed Perception In Case Studies Accidents

Impediments to vision. In these accidents, there were barriers to clear perception of objects on a collision course, and the collision vehicle was not seen until after the "point of no escape." Impediments to vision as observed in the Case Studies accidents were seldom completely impenetrable, but generally added to the difficulty of the driver's perceptual task, thus increasing the probability of failure. For example, a row of parked cars, inferred to be an impediment to vision, contains gaps between the vehicles, and it is possible to observe some events through the windows and windshields. At the same time, the task of perception becomes much more difficult when parked cars intervene between two vehicles on a collision course.

1. Impediments within the person. At least one accident involved poor vision on the part of a driver. The problem was one of insufficient visual acuity at a distance.

2. Impediments within the vehicle. A principal source of impediments was substandard conditions of the windshield, such as the presence of dirt, rain, tree droppings, and ice. Opaque members of the vehicle body, and poorly placed accessories, such as rear-view mirrors, were found to block the driver's view. In one instance, passengers in the front seat of the vehicle interfered with perception of a collision course.

3. Impediments within the environment. The environment provides a wide variety of conditions that hinder the driver in his perceptual task. Very frequently, cars parked near intersections served this function. Vehicles in the trafficway also became impediments to vision, particularly where the vehicle was stopped in the roadway prior to making a turn at an intersection. Items in the vicinity of the roadway on adjacent residential or commercial land were found in many cases to have made perception of a collision course difficult or impossible. Examples were houses and other buildings, trees and bushes, fences, commercial signs, and landscape retaining walls. Finally, certain conditions of weather and lighting operated to reduce visibility without affecting the windshield of the vehicle. Examples were the glare of a low sun in the driver's eyes, and rain and snow in the face of a motorcyclist.

Inattentiveness. In these accidents, the collision object was visible, but the driver was not attending to it. Since it appears that in normal driving, attention shifts from moment to moment, it is likely that, given more time, the driver would have sighted the hazard in most cases.

1. Inadequate scanning habits. The rational, game-theory, driver would distribute his scanning of the environment according to the likelihood of a collision course developing in various directions. In certain instances drivers failed to look in a direction from which the appearance of hazard was quite probable. In particular, this occurred when, in alighting from a parked car and in entering a traffic lane from a parked position, drivers failed to look to the rear.

2. Preoccupation. In at least one case, a lone driver failed to perceive the collision object in part because of intense concentration on private problems.

3. Distraction from a source within the vehicle. Passengers were frequently found to be distracting influences for the driver, especially when they were children whose physical activity created minor hazards in the driving compartment. Another instance was the car radio, the effect of which was functionally similar to that of conversation in providing distraction along with diversion. A different type of distraction appeared in the necessity to check vehicle instruments, thus diverting the driver's eyes from the roadway.

4. Distraction from a source in the environment. Two situations, shading into one another, were observed under this category. In both, the driver's attention was diverted from a collision object. In the first situation, this diversion occurred because of an unusual sight or sound emanating from a nonhazardous object, such as a parked car, the interior of a house or yard bordering the street, noncompeting traffic, and the like. In the other, the driver's attention was focused on one hazardous object or situation while a second hazard was operating simultaneously. The second hazard was not seen because of a focus on the first hazard.

5. Inattentiveness to the rear. The project investigated many rear-end collisions. In the majority of these accidents, it appeared that the collision object was not sighted by the preceding driver until it was too late to avoid it. Concentration on the forward sector in driving has a great deal of rational justification. Hazard is more likely to develop in this sector, and the vehicle is more manipulable with respect to hazards that develop ahead, than with respect to hazards that develop behind. Inattentiveness to the rear involves elements of habits and distractions. In some accidents it appears that, had the driver been aware of a vehicle approaching from his rear, he could have avoided the accident, for instance by a less severe stop. However, rear-end collisions are especially likely to result from stopping to avoid a collision in the forward sector, and accidents of this type do not appear potentially avoidable through increased attention to the rear sector.

Erroneous Prediction

Once a vehicle has been perceived and a segment of its course has been observed, the rest of the course must be predicted in order to define it as a collision course or not, and to guide evasive action. Assumptions exist in the driving culture that aid in the prediction of vehicle course. Some of these assumptions are also operative at the level of tactics, at which hypotheses concerning the likelihood of the presence of other vehicles must be formulated, even though these vehicles are not perceived. For example, the assumption that a vehicle on a major street will not stop for one entering the road from a minor street will guide drivers on minor streets to moderate their speed in the vicinity of such intersections so that a quick stop can be made. Reference to tactics is implicit in the remainder of this report and it will not be taken up separately.

Returning to the level of evasive action, where there has been no delay in perception, the driver must form expectations of the behavior of a hazard by somehow extrapolating an observed segment of the path. This task is complex for two reasons. On the one hand, where the hazard is another vehicle, its course cannot be predicted by simple physical extrapolation of its path, because the course of the vehicle is subject to acceleration, braking, and steering on the part of the other driver. In addition, since a social situation is in question, it is reasonable to expect that the other driver will vary his course depending on his assessment of the first driver's intentions. Thus, vehicle course in driving is characterized by its modifiability and its social nature, both of which add to the complexity of the task of prediction.

While prediction of vehicle course is difficult, it is generally quite successful. It can be speculated that if vehicles ran at random along intersecting tracks according to some simple and fixed physical principles, collisions would be extremely common events, predictable with knowledge of the frequency of vehicles on each track and the dimensions of the vehicles. With the intentional modifications of course permitted by human control of vehicles, collisions would appear to be strikingly few when compared with the opportunities presented by the crowded highways of recent times.

A prompt and correct prediction of course is necessary for rational and effective evasive action even though this action may still fail for reasons concerning the skill and ability of the driver.

The information potentially available to drivers in predicting the behavior of a hazard is of three types: first, the immediate situation, including the state of the roadway, distance and speed of the hazardous vehicle, obstacles and controls in the environment, and the like, is available to the driver through his visual apparatus. A second type of information is stored knowledge, including physical principles and driving norms. With his knowledge derived from past experience, the driver can estimate the range within which a change of course is possible for both vehicles. Driving norms are generalized expectations concerning both how drivers should drive and how they do in fact drive. Norms need not be consistent, and instances of contradiction between them, especially between items referring to ideal behavior and items referring to usual behavior, can be shown. Normative expectations can be discussed in terms of legitimacy, or approximation to official requirements, and prevalence, or the degree to which they are shared by the driving public. A third type of information that is potentially available in a given situation is communication between drivers. This information differs from the first type in that the stimuli are meaningful through convention alone. It is related to the second type in that signalling behavior is normative behavior.

In predicting the course of a hazard, a driver perceives a short segment of its path and notes certain salient features of the environment. His knowledge of physical principles allows him to narrow the range of possible future positions of the hazard. For instance, it would be unlikely that a vehicle approaching on an intersecting road at 60 m.p.h. and at a distance of 100 feet, could stop before entering the intersection, though the driver of that vehicle be completely intent on making the stop and brake with all his might. Furthermore there are normative expectations. If a vehicle is approaching from a considerable distance on an intersecting road, and is known to be facing a red light, a likely expectation for the driver making the prediction is that the competing vehicle will stop for the light. Finally, messages emitted by other vehicles will be taken into account. If an approaching vehicle is blinking a light on its left front fender, a driver will expect a left turn.

The validity of predictions and expectations of behavior thus depends on the driver's perception of the physical situation, the accuracy of his estimation of physical principles bounding the other's freedom of action, the legitimacy and prevalence of the relevant driving norms, and the accuracy and adequacy of any communication occurring.

The accident histories in Experimental Case Studies of Traffic Accidents were reviewed with the goal of determining the expectations of driving behavior that were held by the drivers involved. It is assumed that the expectations that proved false or misleading in accidents are usually valid. They became apparent when they fail, but they succeed in innumerable instances of traffic conflict, when they are not apparent. In some case histories, the expectations were made explicit by the accident participants, in statements such as, "I thought he would stop." More commonly, it was necessary to construct the expectation by studying closely the attempted evasive action. The listing provided must be considered suggestive rather than demonstrative.

Drivers' Expectations of Vehicle Behavior In Case Studies Accidents

Quasi-physical prediction. Apparently the most general and important assumption made by drivers with respect to the behavior of others is that they will proceed at the same speed in the same general direction, and in the same lane of the road. This is not unlike expectations one might hold of inanimate objects moving in tracks, and is based on simple physical extrapolation of observed course. It appears to be a conditional expectation, subject to modification upon the receipt of communicated messages from other vehicles, and to cues from the roadway such as traffic lights and other vehicles. Specific instances of this assumption appear in three kinds of accidents noted in the Case Studies.

1. A driver will not make a sudden stop. A rear-end collision was often found to result from an unsignalled stop. Such a situation was encountered in cases where a driver intended a left turn, without signalling this intention, and stopped for competing traffic. A parallel situation was that of stopping for an emergency or hazard of which the preceding, but not the following, driver was aware.

2. A driver will stay in his own lane. Sideswipes and rear-end collisions were noted in cases where, for reasons of emergency or preference, a vehicle changed lanes and thus violated the quasi-physical predictions of a near-by driver.

3. A turn will not be made unless signaled in advance. In cases where the simple physical extrapolation of a path defined it as nonintersecting, turns resulting in intersecting paths violated the quasi-physical predictions apparently present, resulting in accidents.

Prediction contingent on communication. Quasi-physical prediction appears specifically contingent on the absence of signals. If a signal is given and received, definite alternative expectations are elicited. The expectations will vary with the type of signal, the major categories of which are right turn, left turn, and stop. These signals are relatively unambiguous and are embodied in the law. It is likely that other messages can be given in certain situations, but their form and content are not as standardized, and the case histories do not appear to contain them. Probable instances are: "Dim your lights," "Yield the way to me," "Get into the right lane," etc.

1. A vehicle emitting a standard signal for a turn will not proceed straight ahead, but will turn at the nearest intersection in the direction signaled. Several accidents were observed where vehicles signaled turns but either proceeded ahead or stopped.

Prediction contingent on the traffic control system. Where a driver perceives and correctly interprets a sign or signal from the traffic control system, he will tend to expect other units approaching from the same direction to behave as he does. Furthermore, there appears to be a tendency to assume symmetry in the control system (e.g., where a green light faces south, that there will be a green

light facing north and red lights facing east and west). Where symmetry is assumed, the behavior of drivers approaching from different directions will be subject to further expectations. When a second unit fails to perceive or to comprehend a signal or sign, or where the expected symmetry does not exist because of unsual conditions, predictions contingent on the traffic control system will be violated. Three types of accidents involving these predictions were noted in the accident histories.

1. Vehicles approaching an intersection with a stop or yield sign will slow or stop to permit vehicles on the favored street to pass through the intersection. In several accidents this assumption was not fulfilled because the sign was not seen, was misinterpreted, or, in the case of the yield sign, its instructions were not specific enough to be correctly followed.

2. Vehicles approaching an intersection where there is a red or amber traffic light will stop. This assumption seems to be even more strongly held than that concerning stop and yield signs. Furthermore, there appears a strong temptation for drivers approaching a traffic light to assume symmetry, since when a sign appears, its presence is not marked on the favored street, while faces of a traffic light are usually visible in various directions. Where traffic lights are not symmetrical, where they are subject to mechanical difficulties, or where drivers fail to receive their messages, accidents occur.

3. Vehicles will move on a green signal, or, by extension, will not stop when a green signal is imminent. This assumption was violated where a green signal was not perceived, and where the expectation of a signal change was not fulfilled.

Situational predictions. Various common traffic situations appear to evoke specific expectations that are not readily classifiable under general headings. Cues can be the type of traffic unit, the type of intersection, the position of the traffic unit, and spatial relation of traffic units to each other. Generally, the presence of these specific expectations is indicated by only a few accidents in the accident histories studied, and this list may be considered incomplete, since the addition of new accidents in the list would appear likely to add new situational hypotheses.

1. At an intersection between a major street and a minor street, alley, or private driver, traffic from the less important road will not enter the more important road if there is competing traffic present.

2. Pedestrians will stop for vehicles when not in a crosswalk. At a crosswalk, pedestrians assume that drivers will stop.

3. Vehicles in a given roadway will move together and in opposite directions simultaneously.

4. Traffic will move in a range of speeds with a higher and lower limit, depending on the circumstances. This range will be higher on an open highway, lower on congested streets and in alleys.

5. Vehicles will not back up when stopped in a traffic lane. This appears to be a conditional hypothesis, subject to modification in a situation including a vacant parking space, or when back-up lights are illuminated, but there is no evidence on these qualifications in the cases.

6. Parked cars are stationary and inert. In particular, their doors will not open into traffic.

7. Traffic from the rear will stop, slow, or pass, depending on the possibilities. This assumption is related to the lack of attentiveness, noted above, concerning hazards from the rear, and is apparent in the same cases.

Reasons for the Failure of Expectations

The reader reviewing the above list of expectations may obtain the impression that those are quite reasonable descriptions of probable vehicle behavior. It is here maintained that these expectations are in fact frequently valid descriptions of driving behavior, and aid drivers in taking evasive actions time and time again without leading to accidents. There are, however, several conditions under which these assumptions become sources of accidents, rather than aids to successful driving. These conditions will be termed insufficient cues, variant action, and deviant action.

In the condition of insufficient cues, a prediction of behavior is made where important aspects of the situation are unknown or unperceived by the driver. If the information were available, the driver would probably make different predictions. Some of the reasons for the unavailability of cues are impediments to vision and inattentiveness, identical with the conditions discussed under delayed perception in an earlier section, except that the previous discussion was restricted to knowledge of the presence of the collision object. It is quite possible to realize that another is present, but to predict its course erroneously, as when a vehicle is seen but its signal to turn is not. Furthermore, in the condition of insufficient cues, the object not perceived is not necessarily the collision object. As an instance, consider three cars driving in line. The second car obstructs the view of the first car from the driver of the third car. If the second car stops abruptly because of some hazardous action of the first, the third driver's quasi-physical predictions will be violated, and, if the third car is in a tactically poor position, an accident may result. The collision object is clearly perceived, but it forms an obstacle to the perception of an important situational cue to the following driver's prediction of its course.

Another reason for insufficient cues is that the environment may fail to provide information that is normatively expected. For instance, mechanical failure in a traffic light, resulting in the absence of a phase, will make inappropriate those predictions based on the assumption of this phase.

Cues can be insufficient if a given driver does not possess the knowledge to interpret them correctly. This is exemplified in the confusion of drivers new to a state, as to the meaning of hand signals in the new jurisdiction. Novel road signs, unusual conditions of the roadway surface, and similar items will lead to erroneous expectations of this type.

Reference to the condition of variant action points out that drivers often have several legitimate choices of action at any given moment, and predictions of behavior must allow for this latitude. Satisfactory tactics make this allowance. While a prudent driver will be guided by expectations concerning the behavior of other vehicles, he does not act in such a manner that he is committed to the fulfillment of these expectations. Rather, he proceeds at a speed and in a relationship to other vehicles such that he can revise his expectations if necessary and change his behavior accordingly. The greater the probability that a driver assigns to an expectation, or the more positive he is that a particular course of action will take place, the more committed he can be. Thus, cars proceeding along a limited access highway in a rush hour tend to make heavy commitments to quasi-physical predictions about the behavior of others, and travel closely together at high speeds. However, all situations contain possibilities of

variant action, such as the sudden stop for emergencies, and some situations contain clear-cut variant alternatives. For instance, a car approaching a traffic light in a yellow phase may legitimately proceed through the intersection or stop. A driver observing this situation and making a prediction thereon runs a high risk of finding it invalid. If his tactical position forces a definite commitment to action depending on such a prediction, the chance of an accident is relatively great.

In the condition of deviant action, a driver performs an action which is illegitimate and improbable in the light of prevalent driving norms. An example is failure to turn when the turn signal is activated. Deviant action does not imply anti-social motivation. Such action can occur because of poor comprehension of a situation, as when a traffic light is not seen, or through negligence, as well as through *mens rea.* The prudent driver will adjust his tactical situation to allow for the possibility of deviance, but it would appear that even the best drivers will, on occasions, be committed to expectations that can be violated by deviant action, if traffic flow is to be efficient. Furthermore, since the human span of attention is limited, reliance on norms can be used to direct attention to areas in which hazard is most likely at the expense of relatively safe areas. Thus functional aspect of traffic norms would be disturbed by an overconcern for the possibilities of deviant action.

Suggestions for Reducing Traffic Accidents

Ignorance of collision course entered as a factor in the majority of accidents studied in Experimental Case Studies of Traffic Accidents. It follows that methods of improving drivers' knowledge of collision course will reduce the number and seriousness of traffic accidents, and, if the sample of accidents reported in the Case Studies is representative of accidents in general, this reduction can be quite significant.

Avoidance of these accidents depends on the removal of impediments to vision and the establishment of attentiveness in appropriate directions, on the one hand, and the establishment of congruence between expectations and action on the other hand. With these categories in mind, a few suggestions can be offered concerning accident prevention.[4]

Perhaps the most practical and least costly approach to avoiding accidents similar to the ones discussed here, would be the elimination of fixed impediments to vision. The legislator, the traffic and highway engineer, and other agents of the community concerned with traffic safety are in a position to eliminate such items as signs, bushes, trees, poles, and, above all, vehicles parked near intersections, as these were so frequently found to play the role of vision obstructions. With a 30 m.p.h. speed limit, such items should be prohibited within 100 feet of intersections. While outstanding permanent obstructions are often noticed and removed as found on many road and street systems today, the prevalence of these obstructions and the major role they appear to play in accidents, coupled with the relative ease of eliminating them, suggests that much more should be done. Moving impediments are much more difficult to deal with, and are probably best managed through driver education stressing the danger of proximity to other vehicles in intersections.

Most impediments to vision in the vehicle have been eliminated with modern vehicle design, but the rear-view mirror in many cars is still a hazard to forward vision, as are such embellishments as religious statuettes, rubber dice, and other adult toys noticed in the Case Studies. The placement of such items in the vehicle should be prohibited by law. Driver licensing vision examinations, repeated periodically, may be the way to control similar factors in the individual.

Attentiveness is a much more difficult problem. A first need is research designed to estimate the probability of hazards in particular segments of potential vision. Results of this research, along with assessments of the potentiality of doing things about hazards in these directions, should be used to work out a desirable scanning pattern, which must then be taught through driver education. Some systems of driver education have made a beginning in this direction, and might be made more effective with a basis in scientific research. Another approach would be to eliminate sources of distraction wherever possible. Typical examples are flashy advertising signs in the road, and complicated and obscure instruments in the vehicle.

Probably the most difficult category to deal with is erroneous predictions. Most of the expectations cited above are bolstered by law, and they appear to be substantiated in driving experience in countless common events. They are the basis of efficient traffic flow, and to question them too strongly might drastically reduce the efficiency of the flow. For instance, without the assumption that conflicting traffic will stop for a red light, many vehicles entering a heavily traveled urban intersection on a green light, would have to slow to nearly a stop before proceeding. Insufficient cues might be reduced by techniques similar to those recommended for impediments to vision, and by standardization of laws and administrative practices between jurisdictions.

Research designed to estimate the probability with which varied and deviant courses of action actually occur, would be of help to drivers in forming expectations of vehicle course. Perhaps the development of a more versatile signal system, allowing drivers to specify to each other which of several possible and legitimate courses of action they plan to take, and to what degree, would be helpful. In some situations a feed-back signal, acknowledging receipt of a message, would be useful. The bulk of responsibility for minimizing the invalidity that variant and deviant action create for expectations must go to driver training, which should emphasize the hazards of commitment to expectations and the benefits of a good tactical position. This is what is commonly taught under the term "defensive driving."

REFERENCES

1. Portions of this section are adapted from J. Stannard Baker and H. Laurence Ross *Concepts and Classification of Traffic Accidents Causes,* Report No. 11.

2. *Cf.* H. Laurence Ross, "Schematic Analysis of the Driving Situation," *Traffic Safety Research Review,* Vol. 4, No. 3, September, 1960, pp. 4-7, and Report 12.

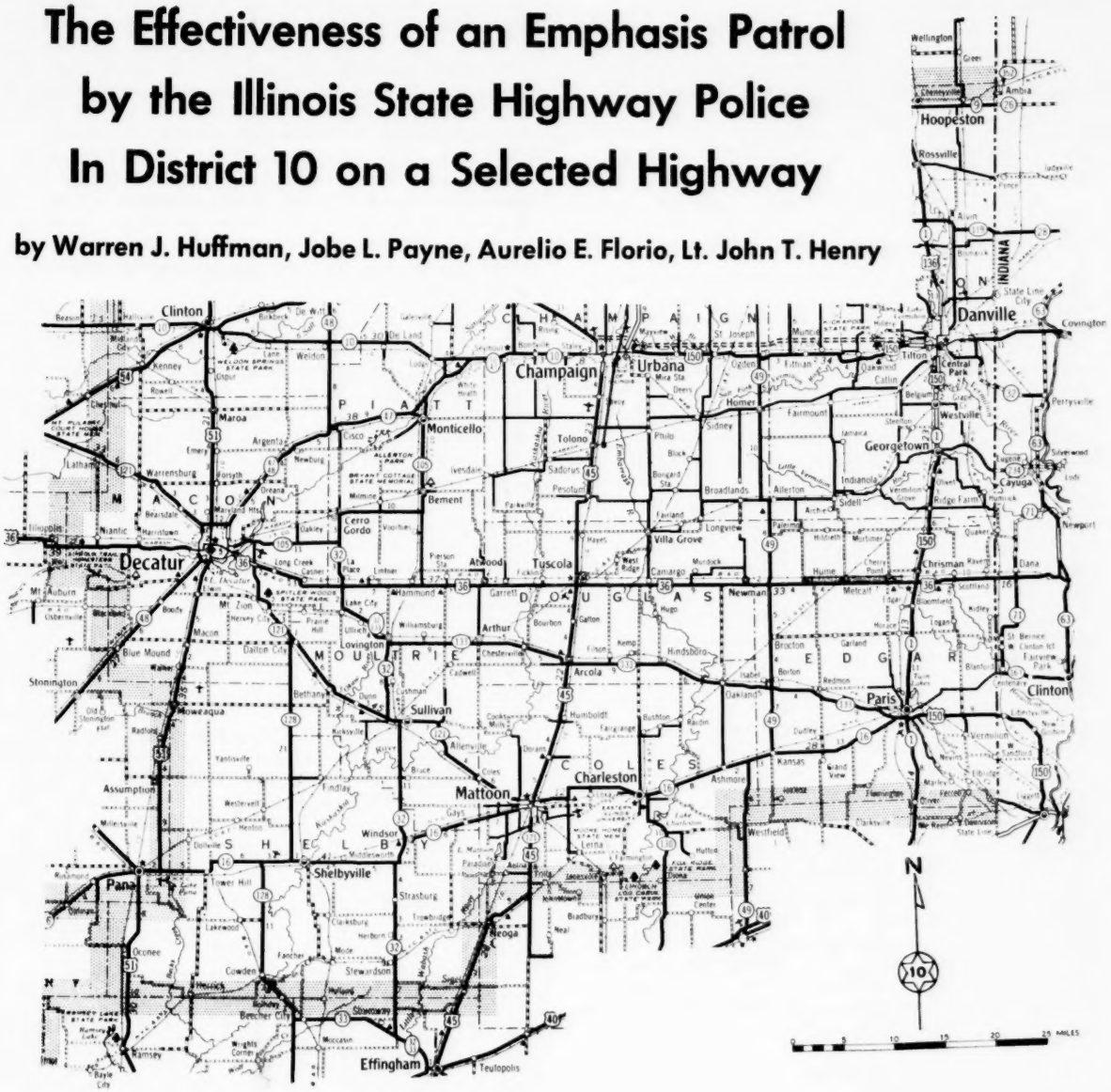
3. Brief descriptions of the accidents are available in H. Laurence Ross and Robert B. Mack, "Synopses of Accidents in Experimental Case Studies of Traffic Accidents," Report No. 21.

4. Portions of this section were read in a paper presented at the National Safety Congress on Oct. 17, 1960. These portions have been reprinted in the *Traffic Digest and Review,* Vol. 8, No. 12, Dec. 1960, pp. 4-8.

   A more extensive discussion of accident prevention based on the Case Studies experience appears in H. L. Ross, R. B. Mack and M. F. Young, "Recommendations to Reduce Accidents," Report No. 26.

The Effectiveness of an Emphasis Patrol by the Illinois State Highway Police In District 10 on a Selected Highway

by Warren J. Huffman, Jobe L. Payne, Aurelio E. Florio, Lt. John T. Henry



PRELIMINARY STUDY

Before the Emphasis Patrol was established, Champaign County, Illinois, had a very poor traffic accident record. Before assigning an Emphasis Patrol a review was made of the records of all traffic accidents which had occurred in Champaign County.[1] The reviewing or examining period included the accident experience during the years of 1956, 1957, and the first five-months of 1958. Spot maps were made on each four hour period, by month, of the examining period. This amounted to 174 maps. In addition, spot maps were made showing the accident experience by month of the examining period. This amounted to 32 additional spot maps and brought the grand total of spot maps to 206.

The second phase of the assignment consisted of a review of the arrest reports. Some 27,000 arrest reports for District 10 were handled in order to obtain the amount of enforcement that had been exercised in Champaign County during the examining period.

It took approximately 300 man hours to gather the information in the first two phases. The third phase of the assignment consisted of analysis of the information gathered during the first two phases.

Champaign County had the following accident experience for the year 1956: 23 fatal accidents, 123 personal injury accidents, and 206 property damage accidents. Of these, 43.5 per cent of the fatal accidents, 38.2 per cent of the personal injury accidents, 51.5 per cent of the property damage accidents, and 46.3 per cent of all traffic accidents in Champaign County occurred on T. S. Route 45. (See Table I)

The experience for 1957 was roughly the same when 23 fatal accidents, 138 personal injury accidents, and 255 property damage accidents occurred in Champaign County. Of these 60.9 per cent of the fatal accidents, 50.7 per cent of the personal injury accidents, 45.5 per cent of the property damage accidents, and 48.1 per cent of all traffic

TABLE I

ACCIDENT RECORD OF U.S. 45 AND THE TOTAL TRAFFIC ACCIDENT EXPERIENCE OF CHAMPAIGN COUNTY

Year	Fatal Accidents			Personal Injury Accidents			Property Dam. Accidents			Total Accidents		
	U.S. 45	Total	%	U.S. 45	Total	%	U.S. 45	Total	%	U.S. 45	Total	%
1956	10	23	43.5	47	123	38.2	106	206	51.5	163	352	46.3
1957	14	23	60.9	70	138	50.7	116	255	45.5	200	416	48.1
1958 (1st 5 Mon.)	5	10	50.0	18	47	38.3	37	98	37.8	60	155	38.7
Total	29	56	51.8	135	308	43.8	259	559	46.3	423	923	45.8

accidents in Champaign County occurred on U. S. Route 45. (See Table I)

There was little change in the above experience for the first five months of 1958. During this period there were 10 fatal accidents, 47 personal injury accidents, and 98 property damage accidents. Of this number of accidents, 50.0 per cent of the fatal accidents, 38.3 per cent of the personal injury accidents 37.8 per cent of property damage accidents, and 38.7 per cent of all traffic accidents in Champaign County occurred on U. S. Route 45. (See Table I)

During the two years and five months of the reviewing period 56 fatal accidents, 308 personal injury accidents, and 559 property damage accidents occurred on Champaign County Highways. Of these accidents, 51.8 per cent of the fatal accidents, 43.8 per cent of the personal injury accidents, 46.3 per cent of the property damage accidents, and 45.8 per cent of all traffic accidents in Champaign County occurred on U. S. Route 45. (See Table I) The figures clearly indicate that the accident record for U. S. Route 45 was by far the poorest in the county.

Severity of Accidents

The next question was to determine what section of U. S. Route 45 had the most severe accidents. To study this question the highway was divided into five sections, ranging from five to nine miles, depending upon the geographical location of the towns used as dividing points between the sections. Severity was based on the sum of all fatal accidents and all personal injury accidents divided by the total number of accidents.

TABLE II

SEVERITY OF ACCIDENTS

Year	U. S. ROUTE 45		Remainder of County		Total Recd. of County		Severity Index		
	Fatal & Personal Inj. Acc.	Total Number Accidents	Fatal & Personal Inj. Acc.	Total Number Accidents	Fatal & Personal Inj. Acc.	Total Number Accidents	U.S. 45	Rem. of	Total Cty.
1956	57	163	89	189	146	352	35.0	47.1	41.5
1957	84	200	77	216	161	416	42.0	35.6	38.7
1958 1st 5 mo.	23	60	34	95	57	155	38.3	35.8	36.8
TOT.	164	423	200	500	364	923	38.8	40.0	39.4

There was very little difference between the severity rate of Route 45 and the remainder of the highways in Champaign County. (See Table II) Generally speaking, all of Route 45 had a high degree of severity.

To offset the variation of distances between the sections, the total accident experience was divided by the distance of the section in miles, to arrive at an accident per mile figure. The fifth section, at the southern end of the county had very little accident experience, yet the severity rate was high. Since the accident experience in this section was low, it was recommended that it not be included in the Emphasis Patrol. There was little difference in the accident experience within the remaining four sections. Both the accident per mile rate and the per cent of severity were quite high. For that reason, it was recommended that the Emphasis Patrol take in all of U. S. Route 45, excluding Champaign-Urbana, from Tolono to the north county line which is located at the north edge of Ludlow, a total distance of 29 miles.

Accident Time Study

In addition to the above studies, an accident time study was made. Due to an occasional isolated fatal accident, the fatal accident trend fluctuated; however, during the hours of darkness there was a definite increase. The total accident trend, probably the most accurate, showed that accidents tend to increase between 4:00 P.M. and 12:00 midnight. Between 12:00 midnight and 4:00 A.M. there was a small drop. A definite drop occurred between the hours of 4:00 A.M. and 8:00 A.M. After 8:00 A.M. there seemed to be a small steady rise until 4:00 P.M., when the sharp increase took place.

Accident Month Study

A time study by month was also made. The month of January had the least accident experience. A small rise occurred in February. A sharp increase in accidents occurred during March. The accident rate remained steady during April and May, but began an upswing in June. June, July, and August were the highest months for accidents. A definite drop in the number of accidents occurred during September. The number remained steady during October but started an upswing during November and December. The monthly trend of accidents remained about the same for 1956, 1957, and for the first five months of 1958.

Accident-Driver Age

TABLE III

AGE OF DRIVERS INVOLVED IN ACCIDENTS

Year	Und. 18		18-20		21-24		25-44		45-65		Over 65		Total No.
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
1956	30	4.6	77	11.7	117	17.8	308	47.0	102	15.5	22	3.4	656
1957	38	5.0	89	11.8	130	17.2	335	44.3	137	18.1	27	3.6	756
1st 5 mo. 58	16	6.3	34	13.3	48	18.8	108	42.2	43	16.8	7	2.7	256
Total	84	5.0	200	12.0	295	17.7	751	45.0	282	16.9	56	3.4	1668

Of the total of 656 drivers involved in accidents in Champaign County during 1956, 4.6 per cent or 30, were 18 years of age; 11.7 per cent or 77, were between 18 and 20 years of age; 17.8 or 117, were between 21 and 24 years of age; 47.0 per cent or 308, were between 25 and 44 years of age; 15.5 per cent or 102, were between 45 and 65 years of age, and 3.4 per cent or 22, were over 65 years of age.

During 1957 these figures were approximately the same. Out of a total of 756 drivers involved in accidents (this was exactly 100 more than in 1956) 5.0 per cent or 38, were under 18 years of age; 11.8 per cent or 89, were 18 to 20 years of age; 17.2 per cent or 130, were between 21 and 24 years of age; 44.3 per cent or 335, were between 25 and 44 years of age; 18.1 per cent, or 137, were 45 to

65 years of age, and 3.6 per cent or 27, were over 65 years of age.

Again during the first five months of 1958 there was little change except for a small increase in the young drivers while a drop occurred in the middle bracket. Out of a total of 256 drivers, 6.3 per cent or 16, were under 18 years of age; 13.3 per cent or 34, were between 18 and 20 years old; 18.8 per cent or 48, were between 21 and 24 years of age; 42.2 per cent or 108, were 25 to 44 years of age; 16.8 per cent or 43, were 45 to 65 years of age, and 2.7 per cent or 7, were over 65 years of age.

For the entire period 5.0 per cent or 84, were 18 years of age; 12.0 per cent or 200, were 18 to 20 years of age; 17.7 per cent or 295, were 21 to 24 years of age; 45.0 per cent or 751 were 25 to 44 years of age; 16.9 per cent or 282, were 45 to 65 years of age, and 3.4 per cent or 56, were over 65 years of age. This is definitely an established pattern.

Accidents Involving Trucks

TABLE IV

ACCIDENTS INVOLVING TRUCKS

Year	Total Number	Trucks Number	Trucks Per Cent
1956	653	68	10.4
1957	705	90	12.8
1st 5 Mo. 1958	258	29	11.2
TOTALS	1616	187	11.6

Accidents involving trucks were also surveyed. During 1956, out of a total of 653 motor vehicles involved in accidents, 10.4 per cent or 68 of them were trucks. During 1957, out of a total of 705 motor vehicles involved in accidents, 12.8 per cent or 90 of them were trucks. In the five month period in 1958 11.2 per cent or 29, of the total number of 258 vehicles involved in accidents were trucks. For the entire period, out of a total of 1616 vehicles involved in accidents, 11.6 per cent or 187 were trucks.

Military Personnel

TABLE V

MILITARY PERSONNEL

Year	Total	Military Personnel Number	Military Personnel Per Cent
1956	656	60	9.1
1957	756	39	5.2
1st 5 Mo. of 1958	256	33	12.9
TOTALS	1668	132	7.9

A survey was desired of military personnel involved in accidents, because Chanute Air Force Base is located at Rantoul on Route 45 in the county. The figures given in Table V are accurate as far as the entire county is concerned, but it is believed, percentage wise, that the accident rate around Chanute Air Force Base would be very high as far as military personnel is concerned. During 1956, out of a total of 656 drivers involved in accidents, 9.1 per cent or 60 of them were military personnel. During 1957, of a total of 756 drivers involved in accidents, the number of military personnel involved dropped to 5.2 per cent or 39. However, an alarming increase occurred during the first five months of 1958. Out of a total of 256 drivers, 12.9 per cent or 33, were military personnel. For the entire period, out of a total of 1668 drivers involved in accidents, 7.9 per cent or 132 were military personnel.

Sex of Drivers Involved in Accidents

TABLE VI

SEX OF DRIVERS INVOLVED IN ACCIDENTS

Year	Total	MALE Number	MALE Per Cent	FEMALE Number	FEMALE Per Cent
1956	656	596	90.9	60	9.1
1957	756	648	85.7	108	14.3
1st 5 Mo. of 1958	256	225	87.9	31	12.1
TOTALS	1668	1469	88.1	199	11.9

The preliminary study revealed that out of the 656 drivers involved in accidents during 1956, 9.1 per cent or 60 were females and 90.9 per cent or 596 were males. During 1957, out of a total of 756 drivers involved in accidents 14.3 per cent or 108 were females and 85.7 per cent or 648 were males.

In 1958 for the first five months, out of a total of 256 drivers involved in accidents, 12.1 per cent or 31 were females and 87.9 per cent or 225 were males. For the entire period, out of the 1668 drivers involved in accidents, 11.9 per cent or 199 were females, and 88.1 per cent or 1469 were males.

Enforcement Index

TABLE VII

ENFORCEMENT INDEX

Year	Moving Hazardous Arrests	Fatal Accidents	Personal Injury Accidents	Total-Fatal & Personal Injury Accidents	Enforcement Index
1956	3,439	23	123	146	23.6
1957	2,510	23	138	161	15.6
1958	1,279	10	47	57	22.4
Total	7,228	56	308	364	19.9

There were 3,439 moving hazardous arrests in Champaign County during 1956. As there were 23 fatal accidents, and 123 personal injury accidents during this same period, the *enforcement index* in Champaign County for 1956 was 23.6.[2] During 1957 there were 2,510 moving hazardous arrests made, and 23 fatal accidents plus 138 personal injury accidents occurred, which set the enforcement index at 15.6. This was a 34 per cent drop from the enforcement index of 1956. For the first five months of 1958, 1,279 moving hazardous arrests were made. During this period 10 fatal accidents and 47 personal injury accidents occurred. This set the enforcement index at 22.4. For the entire period, 7,228 moving hazardous arrests were made, 56 fatal accidents and 308 personal injury accidents occurred. This set the enforcement index for the period at 19.9.

Assignment of Manpower to the Emphasis Patrol

An enforcement index of 28 was recommended for the Emphasis Patrol on the basis of the accident experience and arrest record for the reviewing period. The assignment of manpower to the Emphasis Patrol posed quite a problem. Fifteen cars were assigned to Champaign County on a round-the-clock basis before the Emphasis Patrol began. The hours of duty were as follows: 3 cars, 7:00 a.m.-3:00 p.m.; 3 cars, 10:00 a.m.-6:00 p.m.; 3 cars, 3:00 p.m.-11:00 p.m.; 3 cars, 6:00 p.m.-2:00 a.m.; 3 cars, 11:00 p.m.-7:00 a.m. The only selective enforcement noted was that the staggered shifts covered the critical period with 6 out of 15 units, or 40 per cent of the available manpower. This type of planning is good, but it was considered inadequate for the Emphasis Patrol.

The number of arrests for hazardous moving violations averaged about 200 per car per year. This figure of 200 was used as a basis for computing the number of cars needed to achieve an enforcement index of 28. It was assumed that fatal and personal injury accidents would average 150. Multiplying this number by the desired enforcement of 28 equals 4200, the desired number of moving, hazardous arrests. Dividing this number by 200, gives 21, which was the number of cars needed for the Emphasis Patrol.

The six additional cars were added, 3 each, to the 3 p.m.-11 p.m., and 6 p.m.-2 a.m. shifts.

TABLE VIII

SPECIFIC ASSIGNMENT OF EMPHASIS PATROL CARS

Location	7am-3pm	10am-6pm	3pm-11pm	6pm-2am	11pm-7am
No. County Line to Rantoul	1	1	1	2	1
Rantoul to Thomasboro		1	1	1	
Thomasboro to Urbana	1	1	2	2	1
Champaign to Tolono	1	1	1	1	1
TOTAL	3	4	5	6	3

The average number of miles per car was 9.7 on the 7 a.m.-3 p.m. shift, 7.3 on the 10 a.m.-6 p.m. shift, 5.8 on the 3 p.m.-11 p.m. shift, 4.8 on the 6 p.m.- 2 a.m. shift, and 9.7 on the 11 p.m.-7 a.m. shift. However, due to the overlapping of shifts, between 10 a.m. and 3 p.m. there were seven cars or one car every 4.1 miles, between 3 p.m. and 6 p.m. there were nine cars or one car every 3.3 miles, from 6 p.m.-11 p.m., the critical period, there were 11 cars or one car for every 2.6 miles, from 11 p.m.-2 a.m. there were nine cars or one car for every 3.3 miles, and from 2 a.m.-7 a.m. there were a total of three cars or one car for every 9.7 miles.

Indoctrination Meeting of Patrol

Before the Emphasis Patrol was started a meeting was held of all the troopers assigned to this patrol. They were briefed on the objectives and procedures of the patrol and the importance of the role of each trooper to the success of the program.

Time and Location of Emphasis Patrol

The Emphasis Patrol was in operation from July 1, 1958 through December 31, 1958. The Emphasis Patrol covered all of U. S. Route 45, excluding Champaign-Urbana, from Tolono north to the north county line which is located at the north edge of Ludlow, a total distance of 29 miles. (See map in Appendix A)

Other highways in the county were patrolled as needed by patrol units assigned to highways in neighboring counties of district 10.

STATEMENT OF THE PROBLEM

The Emphasis Patrol was employed during the last six months of 1958 because of the general acceptance of the fact that traffic law enforcement reduces the frequency of traffic accidents. As a result of a higher enforcement index the accident frequency rate should be significantly improved over that of a comparable period in the preceding year. Also, it was hoped that the Emphasis Patrol of 1958 would be effective enough to have a carry-over effect into 1959 and thus have a prolonged effect in the lowering the number of accidents.

The two major questions investigated:

1. How does the accident record during the Emphasis Patrol compare with the accident record of a comparable period *prior* to the Emphasis Patrol?

2. How does the accident record during the Emphasis Patrol compare with the accident record of a comparable period *following* the Emphasis Patrol?

In addition to the two major questions investigated, a number of other specific questions were studied:

3. What is the relationship between the enforcement index and the accident rate?

4. Do more accidents occur on some days of the week than on others?

5. Do more accidents occur in certain months of the year than in others?

6. How does the record of arrests for violations compare between the Emphasis Patrol period and a regular patrol period?

7. How do the different occupational groups compare in arrests for violations?

8. How do Air Force personnel compare with other drivers in the number of accidents and arrests for traffic violations?

9. How do the Illinois drivers compare with the out-of-state drivers in the number of accidents and the number of arrests for traffic law violations?

10. How do the different age groups compare in the number of accidents and in the number of arrests for traffic law violations?

11. How do the sexes compare in the number of accidents and the number of arrests for traffic law violations?

12. How do the type of vehicles involved in accidents compare?

STATISTICAL TREATMENT OF DATA

The data used in this study were taken from accident and violation report blanks devised by the State Police. (Summary forms for 1958 and 1959 are given in Appendix B). Since few assumptions can be attached to the data collected in this manner, the chi-square method of treatment was used to analyze the data.

The chi-square test represents a useful method of comparing experimentally obtained results with those to be expected theoretically on some hypothesis. The detailed calculation of the chi-square can be found in any standard statistics book.

ANALYSIS OF DATA

The data involved in this study were collected from identical six-month periods in the years 1957, 1958, and 1959. The period involved was the last six months of each year. The data for 1957 were not complete enough for a detailed comparison with 1958 and 1959. This is a definite limitation of the study.

Accident Record

The accident record for the three six-month periods used for comparative study is given in Table IX.

TABLE IX

ACCIDENT RECORD

Year	Total Accidents	Fatal Accidents	Personal Injury Acc.	Fatal & Personal Inj. Acc.	Property Damage Acc.	Number Killed	Number Injured
1957	112	10	50	60	52	17	100
1958	76	2	32	34	42	3	49
1959	86	1	34	35	51	3	60

The Effectiveness of the Emphasis Patrol

To determine the effectiveness of the Emphasis Patrol chi-square tests of independency were computed on each of the categories shown in table IX. The hypothesis to be tested for each of the categories was Ho: *The accident record is independent of the type of enforcement being used,* or, in other words, the Emphasis Patrol of 1958 was no more effective in preventing accidents than the regular patrol used in 1957. The obtained chi-square scores are given in Table X.

TABLE X

CHI-SQUARE SCORES

Category	1957-1958	1958-1959
Total Accidents	6.89	.62
Fatal Accidents	5.33	.33
Personal Injury Accidents	3.95	.06
Fatal and Personal Injury Accidents	7.09	.01
Property Damage Accidents	1.07	.87
Number Killed	9.80	.00
Number Injured	17.46	1.11

Consulting a chi-square table[3] at the .05 alpha or significance level and one degree of freedom, a value of 3.841 is found. The obtained chi-square value is greater than the table value in all of the categories except property damage accidents, the least important of the categories. Therefore, the null hypothesis *the accident record is independent of the type of enforcement* should be rejected and the alternate hypothesis accepted.

These figures become more meaningful when comparing the actual numbers in the different categories in Table IX. These differences and the percentage of differences are shown in Table XI.

TABLE XI

A COMPARISON BETWEEN 1957 AND 1958

Year	Total Accidents	Fatal Accidents	Personal Injury Accidents	Fatal & Personal Injury Acc.	Property Damage Acc.	No. Killed	No. Injured
1957..	112	10	50	60	52	17	100
1958..	76	2	32	34	42	3	49
Diff...	—36	—8	—18	—26	—10	—14	—51
Per Cent Diff...	32	80	36	43	19	82	51

There was a reduction in total accidents of 36 or 32 per cent, fatal accidents of 8, or 80 per cent, with 14, or 82 per cent fewer lives lost, a reduction of 18 or 36 per cent personal accidents in which 51 or 51 per cent fewer people were injured. When fatal and personal injury accidents are combined into a single category considered as severe accidents, there was a reduction of 26 or 43 per cent of such accidents. The reduction in property damage accidents was not statistically significant as shown in Table X, although there was an actual reduction of 10 accidents or 19 per cent.

These comparisons between the record of the Emphasis Patrol period with a similar period preceding the patrol show that the Emphasis Patrol WAS EFFECTIVE IN REDUCING the number of accidents, and particularly in reducing the more severe accidents.

The Carry-Over Effect of the Emphasis Patrol

To determine the carry-over effect of the Emphasis Patrol, chi-square tests of independency were computed on each one of the categories shown in Table IX. The hypothesis to be tested for each of the categories was Ho: *The Accident Record is independent of the type of enforcement being used,* or, in other words, the accident record in 1959 was no different from that of 1958. The obtained chi-square scores are given in Table X.

The obtained chi-square value is less than the table value of 3.841 in all of the categories. There is no reason to doubt that the null hypothesis is true. *The accident record is independent of the type of enforcement being used.* The difference in the accident record is not great enough to be statistically significant. The difference between the two years in each of the categories are given in Table XII.

TABLE XII

A COMPARISON BETWEEN 1958 AND 1959

Year	Total Accidents	Fatal Accidents	Personal Injury Accs.	Fatal & Personal Inj. Accs.	Accs. Property Damage	No. Killed	No. Injured
1958 ..	76	2	32	34	42	3	49
1959 ..	86	1	34	35	51	3	60
Diff. ..	10	— 1	2	1	9	0	11
Per Cent Diff. ..	13	—50	6	3	21	0	22

The number of accidents in all categories except fatal accidents were slightly higher in 1959 than in 1958. There was one more fatal accident in 1958 than in 1959, but the number of fatalities remain the same. Generally speaking, the Emphasis Patrol appears to have had a carry-over influence in 1959.

Comparison of the Pre- and Post-Emphasis Patrol Periods

Chi-square values for each of the categories were computed between the Pre- and Post-Emphasis Patrol periods. The obtained chi-square scores are given in Table X.

Significant differences were obtained in the number of fatal accidents, fatal and personal injury accidents, the number killed, and the number injured. Even though significant differences were not obtained for every category, there was a reduction in every category in 1959 in the Post-Emphasis Patrol period over that of the Pre-Emphasis Patrol Period in 1957. (See Table XIII)

TABLE XIII

A COMPARISON BETWEEN 1957 AND 1959

Year	Total Accidents	Fatal Accidents	Personal Injury Accs.	Fatal & Personal Inj. Accs.	Property Damage Accs.	No. Killed	No. Injured
1957 ..	112	10	50	60	52	17	100
1959 ..	86	1	34	35	51	3	60
Diff. ..	26	9	16	25	1	14	40
Per Cent Diff. ..	23	90	32	42	2	82	40

There has been a downward trend in severe accidents on the highways of Illinois during the past two years. This may account for some of the differences between 1957 and 1959, but it is believed that the Emphasis Patrol did have a continuing effect into 1959 and was responsible for some of the favorable results.

Enforcement Index and Accident Frequency[4]

To determine the relationship between the enforcement index and the accident frequency, a chi-square test of independency was computed. The hypothesis to be tested in this case was Ho: *The accident frequency is independent of the enforcement index in force.*

The range of the weekly enforcement indices in 1959 was from 7-133. Since there was only one index over 100, it was decided to divide the indices into three categories: 0-33, 34-66, and 67 plus. In 1958 the enforcement indices

TABLE XIV

ENFORCEMENT INDEX AND ACCIDENT FREQUENCY

1958

Range of Indices	0-33	34-66	67+	TOTAL
Observed No. of Accidents	42	22	12	76
Expected No. of Accidents	25.33	25.33	25.33	

1959

Range of Indices	0-33	34-66	67+	TOTAL
Observed No. of Accidents	38	12	24	74
Expected No. of Accidents	24.67	24.67	24.67	

ranged from 0-131.[5] Here too, it was felt that a division into thirds would be justifiable. The same three categories were used and the accidents tallied in the proper category. (See Table XIV)

The computations for 1958 resulted in a chi-square of 18.44 and those for 1959 resulted in a chi-square of 13.73. In both cases the alpha level or significance level was .05 and the degrees of freedom were two (2). Consulting a chi-square table at the .05 level and two degrees of freedom a value of 5.991 is found. The values of 18.44 and 13.73 both exceed the table value; thus it can be concluded that the null hypothesis should be rejected in this case. As a result of this rejection the alternate conclusion: The accident frequency is dependent on the enforcement index can be accepted. Generally, it has been found that as the enforcement index goes up the accident rate goes down.

Accident Frequencies According to Days of Occurrence

Do more accidents occur on some days of the week than on others? If so, the highway patrol should be deployed according to the findings in order to have its maximum effectiveness.

A comparison of accident frequencies according to days of occurrence was made of each of the three six-month periods studied. The hypothesis tested was Ho: *The accident frequency is independent of the day of the week.*

TABLE XV

A COMPARISON OF ACCIDENT FREQUENCIES ACCORDING TO THE DAYS OF OCCURRENCE

1957

	S	M	T	W	Thur.	Fri.	Sat.	Total
Observed Frequencies	12	23	10	12	12	19	24	112
Expected Frequencies	16	16	16	16	16	16	16	

1958

	S	M	T	W	Thur.	Fri.	Sat.	Total
Observed Frequencies	16	8	5	10	7	17	13	76
Expected Frequencies	10.86	10.86	10.86	10.86	10.86	10.86	10.86	

1959

	S	M	T	W	Thur.	Fri.	Sat.	Total
Observed Frequencies	16	12	7	8	6	20	17	86
Expected Frequencies	12.28	12.28	12.28	12.28	12.28	12.28	12.28	

From Table XV the pattern of frequency can be ascertained.. The week-ends tend to be the worst for accidents.

In 1957 the value obtained for the computed chi-square was 13.87; in 1958 the value was 11.60, and in 1959 the value was 14.76. The value in the chi-square table at an alpha level of .05 and six degrees of freedom is 12.592. In 1957 and in 1959 the obtained chi-square exceeded the table value. For these two years the null hypothesis: The accident frequency is independent of the day of the week is rejected. It can be concluded that the day of the week is definitely a factor in determining the frequency of accidents during the week.

During 1958 an unusually large number of accidents occurred on the Wednesday preceding Christmas and on New Year's Eve. Therefore, the 1958 chi-square was not significant, and the null hypothesis could not be rejected.

From these comparisons it can be concluded that accidents tend to increase on the weekend and decrease during the week except when a holiday falls on a day other than Friday, Saturday, or Sunday.

Accident Frequencies According to Month of Occurrence

A comparison was made of accident frequencies according to the month of occurrence to find out if there was an established monthly pattern. The hypothesis tested was Ho: *The accident frequency is independent of the month of occurrence.*

TABLE XVI

ACCIDENT FREQUENCIES ACCORDING TO MONTH OF OCCURRENCE

1957

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Observed Frequencies	13	21	11	19	24	24	112
Expected Frequencies	18.66	18.66	18.66	18.66	18.66	18.66	

1958

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Observed Frequencies	11	9	15	8	15	18	76
Expected Frequencies	12.66	12.66	12.66	12.66	12.66	12.66	

1959

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Observed Frequencies	14	19	17	13	15	8	86
Expected Frequencies	14.33	14.33	14.33	14.33	14.33	14.33	

The chi-square value for 1957 was 8.21, for 1958, 6.03, and for 1959, 5.03. The value in the chi-square table at an alpha level of .05 and five degrees of freedom is 11.07. None of the obtained values are as great as the table value. There is no reason to doubt that the null hypothesis is true. The accident frequency is independent of the month of occurrence.

Comparison of the record for violations during the Emphasis Patrol period and a Regular Patrol Period[6]

There was no significant difference in the total number of arrests for violations between the Emphasis Patrol period in 1958 and a regular patrol period in 1959. (See Table XVII). There was a significant increase in the number of arrests for speeding violations, but this was off-

set by a significant decrease in total arrests for other moving hazardous violations and for total non-moving violations.

Radar checks for speeding were used more extensively in 1959 which probably accounts for the significant increase in arrests for speeding violations. During the early phase of the Emphasis Patrol period there was vigorous enforcement of the law requiring out-of-state transfer vehicles to have reciprocity plates for Illinois. This could account for the much greater number of arrests for improper vehicle licenses in 1958 than in 1959.

There may have been a carry-over effect from the Emphasis Patrol in 1958 to 1959 to account for part of the decrease in arrests for violations in most of the categories except speeding. However, it is believed that much of the decrease can be attributed to the fact that since fewer units were patrolling the area many violations in 1959 went undetected.

TABLE XVII

TRAFFIC VIOLATION

VIOLATIONS	1958	1959	Chi-Square*
Speeding	892	1236	55.61
Illegal Passing	132	38	51.98
Improper Turning	13	6	2.58
Failed to Yield	24	30	.67
Disobeyed Stop	122	55	22.36
Following Too Close	17	10	1.74
Drunken Driving	29	31	.07
All moving hazardous arrests	60	30	10.00
Other moving hazardous arrests, except speeding	397	200	65.00
Total moving hazardous arrests	1289	1436	7.92
Op.-Chauf. License	116	58	19.33
Vehicle License	92	24	39.86
Defective Equipment	35	36	.01
Other—Non-Moving Violations	134	95	6.64
Total non-moving violations	377	213	45.59
Total arrests for violations	1666	1649	.09

*Alpha level .05 and one degree of freedom=3.841

quently traveling to and from work, and were more likely to be caught by radar in 1959 for speeding than in 1958 when radar was used less extensively. Approximately 87 per cent of all arrests for speeding involved these two groups (25 per cent and 62 per cent respectively). There was no significant increase in arrests for the Air Force personnel for speeding, but there was a significant decrease in speeding arrests for other Military Service Personnel.

There was a significant decrease in arrests for all moving hazardous violations except speeding for the Air Force, White Collar, and the Miscellaneous Labor groups. The decrease for the last two groups was due mainly to the decrease in arrests for illegal passing and disobeyed stop signs. Air Force personnel showed a decrease in disobeyed stop signs, drunken driving, and other moving hazardous arrest categories.

Only the Miscellaneous Labor group showed a significant increase in total moving hazardous arrests in 1959 over 1958. This occurred despite the decrease in moving violation arrests in other categories because of the marked increase in arrests for speeding. The Other Services groups showed a significant decrease in total moving hazardous arrests mainly because of their decrease in arrests for speeding violations.

All groups showed a decrease in arrests for non-moving violations and except for the Student Group the decreases were statistically significant. The Miscellaneous Group showed the greatest drop in arrests. This can probably be accounted for by the marked drop in arrests for vehicle licenses. Involved more than any other group in driving out-of-state transfer vehicles lacking reciprocity plates.

The Air Force and other Service Groups showed a significant decrease in total arrests for violations in 1959 over 1958. This probably reflects an increased concern by the Air Force and other military leaders for the traffic safety

TABLE XVIII

VIOLATION ARRESTS ACCORDING TO OCCUPATIONS

VIOLATIONS	Air Force			Other Services			Students			White Collar			Miscellaneous Labor		
	1958	1959	Chi-* Square	1958	1959	Chi-* Square	1958	1959	Chi-* Square	1958	1959	Chi-* Square	1958	1959	Chi-* Square
Speeding	66	80	1.34	14	2	9.00	53	70	2.34	217	310	16.41	542	774	40.90
Illegal Passing	5	2		0	0		8	4		46	2		73	30	
Improper Turning	2	1		0	1		3	0		4	3		4	1	
Failed to Yield	4	6		0	0		6	5		6	9		8	10	
Disobeyed Stop Sign	20	6		0	0		13	13		29	10		60	26	
Following too Close	4	1		0	0		2	0		4	1		7	8	
Drunken Driving	10	4		0	0		0	0		5	9		14	18	
Other Moving Hazardous Arrests	14	7		2	2		3	6		10	6		31	9	
All Moving Hazardous Arrests Except Speeding	59	27	11.91	2	3	.20	35	28	.78	104	40	28.44	197	102	30.18
Total Moving Hazardous Arrests	125	107	1.40	16	5	5.76	88	98	.54	321	350	1.25	739	876	11.62
Op.-Chauf. License	9	2		4	0		11	6		25	12		67	38	
Vehicle License	5	1		0	0		4	4		10	4		73	15	
Defective Equipment	6	4		0	0		4	6		5	11		20	15	
Other non-moving Violations	11	4		2	1		7	3		12	5		102	82	
Total non-moving Violations	31	11	9.52	6	1	3.57	26	19	1.08	52	32	4.76	262	150	30.45
Total Arrests for Violations	156	118	5.27	22	6	6.53	114	117	.04	373	382	.11	1001	1026	.31

*Alpha Level .05, one degree of freedom=3.841

Comparison of Arrests for Violations According to Occupational Groups

Violation arrests according to occupations are given in Table XVIII. The percentage of arrests for each classification is given in Table XIX. The proportion of drivers of the different occupational categories using U. S. Highway 45 is not known. Therefore, definite conclusions cannot be made from the figures.

Speeding arrests increased significantly from 1958 to 1959 in the White Collar and Miscellaneous Labor groups. These groups quite likely used the highways more fre-

TABLE XX

RESIDENCE OF DRIVERS INVOLVED IN ACCIDENTS

Year	Total		Air Force		Illinois		Others	
	Drivers Involved Number	No. Dr. Arrested	No.	% of Total	No.	% of Total	No.	% of Total
1958	144	56	20	13.9	109	75.7	15	10.4
1959	151	73	14	9.3	117	77.5	20	13.2
Total	295	129	34	11.5	226	76.6	35	11.9

TABLE XIX

PERCENTAGE OF ARRESTS FOR VIOLATIONS BY OCCUPATIONAL GROUPS

VIOLATIONS	Air Force			Other Services			Students			White Collar			Miscellaneous Labor		
	1958	1959	Total	1958	1959	Total	1958	1959	Total	1958	1959	Total	1958	1959	Total
Speeding	7.4	6.5	6.9	1.6	.2	.8	5.9	5.7	5.8	24.3	25.1	24.8	60.8	62.6	61.8
Illegal Passing	3.8	5.3	4.1	.0	.0	.0	6.1	10.5	7.1	34.9	5.3	28.2	55.3	79.0	60.6
Improper Turning	15.4	16.7	15.8	.0	16.7	5.3	23.1	.0	15.8	30.8	50.0	36.8	30.8	16.7	26.3
Failed to Yield	16.7	20.0	18.5	.0	.0	.0	25.0	16.7	20.4	25.0	30.0	27.8	33.3	33.3	33.3
Disobeyed Stop Sign	16.4	10.9	14.7	.0	.0	.0	10.7	23.6	14.7	23.8	18.2	22.0	49.2	47.3	48.6
Following Too Close	23.5	10.0	18.5	.0	.0	.0	11.8	.0	7.4	23.5	10.0	18.5	41.2	80.0	55.6
Drunken Driving	34.5	12.9	23.3	.0	.0	.0	.0	.0	.0	17.2	29.1	23.3	48.3	58.1	53.3
Other Moving Hazardous Arrests	23.3	23.3	23.3	3.3	6.7	4.4	5.0	20.0	10.0	16.7	20.0	17.8	51.7	30.0	44.4
All Moving Hazardous Arrests Except Speeding	14.9	13.5	14.4	.5	1.5	.8	8.8	14.0	10.6	26.2	20.0	24.1	49.6	51.0	50.1
Total Moving Hazardous Arrests	9.7	7.5	8.5	1.2	.4	.8	6.8	6.8	6.8	24.9	24.4	24.6	57.3	61.0	59.3
Op.-Chauf. License	7.8	3.5	6.3	3.5	.0	2.3	9.5	10.3	9.8	21.6	20.7	21.3	57.8	65.5	60.3
Vehicle License	5.4	4.2	5.2	.0	.0	.0	4.4	16.7	6.9	10.9	16.7	12.1	79.4	62.5	75.9
Defective Equipment	17.1	11.1	14.1	.0	.0	.0	11.4	16.7	14.1	14.3	30.6	22.5	57.1	41.7	49.3
Other non-moving Violations	8.2	4.2	6.6	1.5	1.1	1.3	5.2	3.2	4.4	9.0	5.3	7.4	76.1	86.3	80.4
Total non-moving Violations	8.2	5.2	7.1	1.6	.5	1.2	6.9	8.9	7.6	13.8	15.0	14.2	69.5	70.4	69.8
Total Arrests for Violations	9.4	7.2	8.3	1.3	.4	.8	6.8	7.1	7.0	22.4	23.2	22.8	60.1	62.2	61.2

record of their personnel. The Air Force has instituted a world-wide driver education program for all their young personnel. In addition to a state ticket for a traffic violation, military courtesy tickets are sent to the Fifth Army headquarters and then to the soldier's home unit where they are entered upon his record.

Accident Record of Air Force Personnel

During the preliminary study it was shown that there was an alarming increase of accidents in Champaign County during the first part of 1958 involving military personnel (mostly Air Force). They were involved in 12.9 per cent of all the accidents. This trend continued during the Emphasis Patrol period in which time 13.9 per cent of all the accidents on U. S. Route 45 involved Air Force Personnel. During the last six months of 1959 this percentage dropped to 9.3 per cent. Although the decrease in accidents involving Air Force Personnel was not statistically significant, it does probably reflect the increased efforts to promote traffic safety among the Air Force Personnel.

Comparison of Accident and Traffic Law Violations of Illinois and Out-of-State Drivers

Since the proportion of Illinois to out-of-state drivers is not known, no definite conclusions can be made. The number of Illinois drivers involved in accidents increased in 1959 over 1958 but not enough to be statistically significant. Approximately three out of four drivers involved in accidents in both years were residents of Illinois. (See Table XX).

Violations of Illinois and out-of-state drivers are shown in Table XXI. Unfortunately, violation records for July, 1958, by place of residence were unavailable. Therefore the only comparison that can be made is by comparison of percentages.

Except for several types of violations, Illinois drivers had a slightly higher percentage of violations than accidents. The percentage of violations for Illinois drivers for the two years ranged from 48.4 per cent for improper vehicle licenses in 1958 to 100.0 per cent for "following too close" violations in 1959 with most of the percentages for Illinois drivers falling between 75 per cent and 80 per cent.

Comparison of the Different Age Groups in the Number of Accidents and in the Number of Arrests for Traffic Law Violations

The drivers license Division of the Illinois Secretary of State's office recently completed a statistical analysis of over 3 million drivers by age and sex (November, 1959). The proportion of drivers in each of the categories approximates very closely an analysis of 81 million licensed drivers in the United States recently reported by the Chicago Motor Club in a news release.[7] The Illinois percentages in each age group are given in Table XXII.

For comparative purposes it was assumed that the drivers on U. S. Route 45 follow approximately the same proportion as shown above. Table XXIII shows the number of drivers involved in accidents, the percentage of accidents and the accident index[8] by age, sex, and year.

The three youngest age groups had the worst accident record for both years studied. The worst offenders were 21-24 year olds. This age group had three times as many accidents as they should have according to their proportion to the total number of drivers. These figures may be somewhat misleading since there may be a higher percentage of drivers in this age group in this locality because of the location of the University of Illinois and Chanute Air Force Base along U. S. Route 45. Nevertheless, this record confirms other studies which show about the same thing. The accident record gets progressively better as age increases above 25 years.

Arrests for traffic law violations for females were not recorded by age. Therefore an analysis of arrests for violations by age can only be made of male drivers. (See Table XXIV).

The traffic violations have been combined into five main categories because of the small number in each age group under most of the separate categories. There were no significant increases or decreases in the under 18 year old group and no significant increase of the 18-20 year old group in any of the categories. There was a significant increase in arrests for speeding violations for all of the other groups as well as for the total group.

There was a significant decrease for all moving hazardous arrests except for speeding in the 18-20, 21-24, and 25-44 year age groups. The decrease in each of the other age groups was not great enough to be significant.

The increase in arrests for speeding violations was great enough in the 25-44 and the 45-65 year old groups to offset the decrease in other moving violations and to make a significant increase in total moving hazardous arrests for these two groups as well as for the total group.

There was a decrease in non-moving violations in all age groups. This decrease was statistically significant in the 18-20, 25-44, 65+ age groups as well as for the total group.

TABLE XXII

PROPORTION OF ILLINOIS DRIVERS IN EACH AGE CATEGORY

Age Group	Male	Female	Total
Under 18	1.7	.9	2.6
18-20	3.2	2.1	5.3
21-24	4.4	3.1	7.5
25-44	25.2	18.6	43.8
45-65	20.9	12.1	33.0
65+	5.9	1.7	7.6
Total	61.4	38.6	100.0

TABLE XXI

COMPARISON OF ILLINOIS AND OUT-OF-STATE DRIVERS

VIOLATIONS	1958					1959				
	Total	Ill.	%	Out of State	%	Total	Ill.	%	Out of State	%
Speeding	585	424	72.5	161	27.5	1236	1006	81.4	230	18.6
Illegal Passing	131	120	99.2	11	.8	38	36	94.7	2	5.3
Improper Turning	10	7	70.0	3	30.0	6	5	83.3	1	16.7
Failed To Yield	20	18	90.0	2	10.0	30	26	86.7	4	13.3
Disobeyed Stop	75	62	82.7	13	17.3	55	36	65.5	19	34.5
Following Too Close	8	7	87.5	1	12.5	10	10	100.0	0	.0
Drunken Driving	22	16	72.7	6	27.3	31	25	80.6	6	19.4
Other Moving Hazardous Arrests	47	36	76.6	11	23.4	30	23	76.7	7	23.3
All Moving Hazardous Arrests Except Speeding	313	266	85.0	47	15.0	200	161	80.5	39	19.5
Total Moving Hazardous Arrests	898	690	76.8	208	23.2	1436	1167	81.3	269	18.7
Op.-Chauf. License	82	70	85.4	12	14.6	58	51	87.9	7	12.1
Vehicle License	64	31	48.4	33	51.6	24	21	87.5	3	12.5
Defective Equipment	27	22	81.5	5	18.5	36	28	77.8	8	22.2
Other non-moving Violations	103	58	56.3	45	43.7	95	53	55.8	42	44.2
Total non-moving Violations	276	181	65.6	95	34.4	213	153	71.8	60	28.2
Total Arrests for Violations	1174	871	74.2	303	25.8	1649	1320	80.0	329	20.0

TABLE XXIII

DRIVERS INVOLVED IN ACCIDENTS ACCORDING TO AGE AND SEX

Men

Age	1958 No.	1958 %	1958 Index*	1959 No.	1959 %	1959 Index	Total No.	Total %	Total Index
Under 18	4	2.8	1.7	2	1.3	.8	6	2.0	1.2
18-20	13	9.0	2.8	12	7.9	2.5	25	8.5	2.7
21-24	30	20.8	4.7	27	17.9	4.1	57	19.3	4.4
25-44	47	32.6	1.3	54	35.8	1.4	101	34.2	1.4
45-65	22	15.3	.7	25	16.6	.8	47	15.9	.8
65+	6	4.2	.7	5	3.3	.6	11	3.7	.6
Total	122	84.7	1.4	125	82.8	1.4	247	83.7	1.4

*Index: per cent of accidents in each age group divided by percentage of drivers in each age group.

Women

Age	1958 No.	1958 %	1958 Index	1959 No.	1959 %	1959 Index	Total No.	Total %	Total Index
Under 18	4	2.8	3.1	3	2.0	2.2	7	2.4	2.7
18-20	3	2.1	1.0	2	1.3	.6	5	1.7	.8
21-24	3	2.1	.7	7	4.6	1.5	10	3.4	1.1
25-44	9	6.3	.3	9	6.0	.3	18	6.1	.3
45-65	3	2.1	.2	5	3.3	.3	8	2.7	.2
65+	0	.0	.0	0	.0	.0	0	.0	.0
Total	22	15.3	.4	26	17.2	.5	48	16.3	.4

Total

Age	1958 No.	1958 %	1958 Index	1959 No.	1959 %	1959 Index	Total No.	Total %	Total Index
Under 18	8	5.6	2.2	5	3.3	1.3	13	4.4	1.7
18-20	16	11.1	2.1	14	9.3	1.8	30	10.2	1.9
21-24	33	22.9	3.1	34	22.5	3.0	67	22.7	3.0
25-44	56	38.9	.9	63	41.7	1.0	119	40.3	.9
45-65	25	17.4	.5	30	19.9	.6	55	18.6	.6
65+	6	4.2	.6	5	3.3	.4	11	3.7	.5
Total	144	100.0		151	100.0		295	100.0	

Two groups showed a significant difference between the total arrests for violations in 1958 and in 1959. The 18-20 year old group showed a significant decrease and the 45-65 year old age group showed a significant increase.

The 21-24 year old group had the highest number of violations in proportion to their number in all but one category for the two years. Their indices (per cent of total number of violations divided by the per cent of the total number of drivers in that age group) ranged from 3.5 to 4.7 per cent. This indicates that this age group has from three to five times as many violations as they should have for their numbers. It is significant to note that this group also had the highest accident index.

The next highest group in proportion of arrests for traffic violations was the 18-20 year old group. The under 18 and the 25-44 year old groups were about the same. Generally speaking, as the age increases over 25 the proportion of violations to the number of drivers in each age group decreases.

Comparison of Sexes in the Number of Accidents and in the Number of Arrests for Traffic Law Violations

Men were involved in the greatest number of accidents. They were involved in 84.7 per cent of all accidents in 1958, 82.8 per cent of all accidents in 1959, and 83.7 per cent of all accidents for the two years combined. The men had a greater proportion of accidents in every age group except in the under 18 year age group. The accident index for girls under 18 was 3.1 for 1958, 2.2 for 1959, and 2.7 for both years combined. This compares with 1.7 for 1958, 1.3 for 1959, and 1.2 for both years for the boys under 18. Because of the small number of accidents in this age bracket, caution must be used when interpreting the figures to mean girls under 18 have a poorer record than boys the same age.

Table XXIV

VIOLATION ARRESTS FOR MALES BY AGE

VIOLATIONS	Under 18							18-20						
	1958			1959				1958			1959			
	No.	%	Index	No.	%	Index	Chi-*Sq.	No.	%	Index	No.	%	Index	Chi-*Sq.
Speeding	23	2.6	1.5	26	2.1	1.2	.18	88	9.9	3.1	93	7.5	2.3	.14
Moving Hazardous Arrests Except for Speeding	15	3.8	2.2	7	3.5	2.1	2.91	39	9.8	3.1	18	9.0	2.8	7.74
Total Moving Hazardous Arrests	38	2.9	1.7	33	2.3	1.4	.35	127	9.8	3.1	111	7.7	2.4	1.07
Non-Moving Violations	24	6.4	3.8	13	6.1	3.6	3.27	55	14.6	4.6	20	9.4	2.9	16.33
Total Arrests for Violations	62	3.7	2.2	46	2.8	1.7	2.37	182	10.9	3.4	131	7.9	2.5	8.31

VIOLATIONS	21-24						
	1958			1959			
	No.	%	Index	No.	%	Index	Chi-*Sq.
Speeding	160	17.9	4.1	225	18.2	4.1	10.97
Moving Hazardous Arrests Except for Speeding	72	18.1	4.1	34	17.0	3.7	8.17
Total Moving Hazardous Arrests	232	18.0	4.1	259	18.0	4.1	1.48
Non-moving Violations	58	15.4	3.5	44	20.7	4.7	1.92
Total Arrests for Violations	290	17.4	4.0	303	18.4	4.2	.29

VIOLATIONS	25-44							45-65						
	1958			1959				1958			1959			
	No.	%	Index	No.	%	Index	Chi-*Sq.	No.	%	Index	No.	%	Index	Chi-*Sq.
Speeding	406	45.5	1.8	558	45.1	1.8	23.97	142	15.9	.7	216	17.5	.8	15.30
Moving Hazardous Arrests Except for Speeding	161	40.6	1.6	87	43.5	1.7	22.08	65	16.4	.8	45	22.5	1.1	3.64
Total Moving Hazardous Arrests	567	44.0	1.8	645	44.9	1.8	5.02	207	16.1	.8	261	18.2	.9	6.23
Non-Moving Violations	175	46.4	1.8	97	45.5	1.8	22.37	36	9.5	.5	29	13.6	.6	.75
Total Arrests for Violations	742	44.5	1.8	742	45.0	1.8	.0	243	14.6	.7	290	17.6	.8	4.14

VIOLATIONS	65+							Total						
	1958			1959				1958			1959			
	No.	%	Index	No.	%	Index	Chi-*Sq.	No.	%	Index	No.	%	Index	Chi-*Sq.
Speeding	8	.9	.2	24	1.9	.3	8.00	827	92.7	1.5	1142	92.4	1.5	5.04
Moving Hazardous Arrests Except for Speeding	6	1.5	.3	1	.5	.1	3.57	358	90.2	1.5	192	96.0	1.6	50.10
Total Moving Hazardous Arrests	14	.11	.0	25	.17	.0	3.10	1185	91.9	1.5	1334	92.9	1.5	9.05
Non-Moving Violations	8	2.1	.4	1	.5	.1	5.44	356	94.4	1.5	204	95.8	1.6	41.26
Total Arrests for Violations	22	1.3	.2	26	1.6	.3	.33	1541	92.5	1.5	1538	93.3	1.5	.00

*Alpha level .05 and one degree of freedom —3.841

In all other age groups, except the 21-24 year old group, the women had fewer accidents than would have been expected for their proportion of drivers. The accident index of this group was high because of a sizable increase in accidents in 1959 for women between the ages of 21-24.

As indicated in the preceding section males in the 21-24 year old group had, by far, the worst record of any age group, but the accident record does get progressively better above the age of 25.

The poorer accident record of males is usually explained, at least partially, by the fact that males drive more miles at more peak traffic hours than females. While this is no doubt true, it does not offer a legitimate excuse for the higher proportion of traffic law violations committed by males.

Figures for violation arrests for males are shown in Table XXIV, and for women in Table XXV. A percentage comparison of the sexes is given in Table XXVI, and a comparison of violation indices is given in Table XVII. Traffic law violations by males were discussed in the preceding section on age since violation arrests for women were not recorded by age.

Arrests for traffic violations for females ranged from 1.7 per cent to 18.5 per cent for the two years, 1958 and 1959,

Table XXV

VIOLATION ARRESTS FOR FEMALES

VIOLATIONS	1958			1959			Total			Chi-Square
	No.	%	Index	No.	%	Index	No.	%	Index	
Speeding	65	7.3	.2	94	7.6	.2	159	7.5	.2	5.29
All Moving Hazardous Arrests Except Speeding	39	9.8	.3	8	4.0	.1	47	7.9	.2	20.45
Total Moving Hazardous Arrests	104	8.1	.2	102	7.1	.2	206	7.6	.2	.02
Non-moving Violations	21	5.6	4.1	9	4.2	.1	30	5.1	.1	4.80
Total Arrests for Violations	125	7.5	.2	111	6.7	.2	236	7.1	.2	.83

combined, with the per cent in most categories ranging from five to ten per cent.

There was no significant change in total arrests for either males or females, because the increase in arrests for speeding was offset by a decrease in arrests for other violations.

Approximately nine out of 10 vehicles involved in accidents were passenger cars. Trucks were involved in about nine per cent of the accidents. This shows a favorable decrease when compared with the preliminary study period when trucks were involved in 11.6 per cent of all traffic accidents in Champaign County.

TABLE XXVI

A COMPARISON OF VIOLATION ARRESTS BY SEX & CATEGORY

	1958						1959				TOTAL				
	TOTAL		MALE		FEMALE		TOTAL		MALE		FEMALE		Grand Total	MALE		FEMALE	
	No.	% of Total Arrests	No.	% of Category	No.	% of Category	No.	% of Total Arrests	No.	% of Category	No.	% of Category	No.	% of Total Arrests	No.	% of Category	No.	% of Category
Speeding	892	53.5	827	92.7	65	7.3	1236	75.0	1142	92.4	94	7.6	2128	64.2	1969	92.5	159	7.5
Illegal Passing	132	7.9	118	89.4	14	10.6	38	2.3	38	100.0	0	.0	170	5.1	156	91.8	14	8.2
Improper Turning	13	.8	10	76.9	3	23.1	6	.4	6	100.0	0	.0	19	.6	16	84.2	3	15.8
Failed to Yield	24	1.4	22	91.7	2	8.3	30	1.8	28	93.3	2	6.7	54	1.6	50	92.6	4	7.4
Disobeyed Stop	122	7.3	111	91.0	11	9.0	55	3.3	54	98.2	1	1.8	177	5.3	165	93.2	12	6.8
Following Too Close	17	1.0	14	82.4	3	17.6	10	.7	8	80.0	2	20.0	27	.8	22	81.5	5	18.5
Drunken Driving	29	1.7	27	93.1	2	6.9	31	1.9	29	93.5	2	6.5	60	1.8	56	93.3	4	6.7
Other Moving Hazardous Arrests	60	3.6	56	93.3	4	6.7	30	1.8	29	96.7	1	3.3	90	2.7	85	94.4	5	5.6
Moving Hazardous Arrests Except for Speeding	397	23.8	358	90.2	39	9.8	200	12.2	192	96.0	8	4.0	597	18.0	550	92.1	47	7.9
Total Moving Hazardous Arrests	1289	77.4	1185	91.9	104	8.1	1436	87.1	1334	92.9	102	7.1	2725	82.2	2519	92.4	206	7.6
Op-Chauf. License	116	7.0	104	89.7	12	10.3	58	3.5	52	89.7	6	10.3	174	5.3	156	89.7	18	10.3
Vehicle License	92	5.5	90	97.8	2	2.2	24	1.5	24	100.0	0	.0	116	3.5	114	98.3	2	1.7
Defective Equipment	35	2.1	35	100.0	0	.0	36	2.2	35	97.2	1	2.8	71	2.1	70	98.6	1	1.4
Other Non-moving Violations	134	8.0	127	94.8	7	5.2	95	5.8	93	97.9	2	2.1	229	6.9	220	96.1	9	3.9
Total Non-moving Violations	377	22.6	356	94.4	21	5.6	213	12.9	204	95.8	9	4.2	590	17.8	560	94.9	30	5.1
Total Arrests for Violations	1666	xxxx	1541	92.5	125	7.5	1639	xxxx	1538	93.3	111	6.7	3315	xxxx	3079	92.9	236	7.1

TABLE XXVII

VIOLATION INDEX

VIOLATION	1958		1959		TOTAL	
	Male*	Female	Male*	Female	Male*	Female
Speeding	1.5	.2	1.5	.2	1.5	.2
All Moving Hazardous Arrests Except Speeding	1.5	.3	1.5	.1	1.5	.2
Arrests Ex. Speeding	1.5	.3	1.5	.1	1.5	.2
Total Moving Hazardous Arrests	1.5	.2	1.5	.2	1.5	.2
Non-Moving Violations	1.5	.1	1.5	.1	1.5	.1
Total Arrests for Violations	1.5	.2	1.5	.2	1.5	.2

*The maximum index possible for males is 1.6.

When the violation arrest figures are adjusted according to the proportion of each sex in the total driving population, males had from five to seven and one-half times as many violation arrests as females.

Types of Vehicles Involved in Accidents

TABLE XXVIII

VEHICLES INVOLVED IN ACCIDENTS

Year	Total	Passenger Car		Truck		Bus		Other	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
1958	144	130	90.3	12	8.3	1	.7	1	.7
1959	151	134	88.7	14	9.3	2	1.3	1	.7
Total	295	264	89.5	26	8.8	3	1.0	2	.7

The proportion of the different types of vehicles driven on U. S. Route 45 was not known. Therefore, no definite conclusions can be drawn from the data shown in Table XXVIII.

SUMMARY OF CONCLUSIONS

1. The Emphasis Patrol was effective in reducing the number of accidents, and particularly in reducing the more severe accidents.
2. Even though significant differences were not obtained for every category, there was a reduction in every category of accidents in 1959 in the Post-Emphasis Patrol period over that of the Pre-Emphasis Patrol period in 1957. It is believed that the Emphasis Patrol did have a carry-over effect into 1959 and was responsible for some of the favorable results.
3. Generally speaking, a higher enforcement index was related to a lower accident rate.
4. The day of the week was a significant factor in the accident rate. More accidents occurred on Friday, Saturday, and Sunday, except when a major holiday fell on days other than the weekend.
5. The month of the year was not a significant factor in the accident rate. (Note: Only the last six months of the year were studied).
6. There was no significant difference in the total number of arrests for violations between the Emphasis Patrol period in 1958 and a regular patrol period in 1959. There was a significant increase in the number of arrests for speeding violations, mainly because of increased use of radar, but this was offset by a significant decrease in total arrests for other moving and non-moving violations.
7. White-Collar and the Miscellaneous-Labor Groups tend to violate traffic laws, particularly speeding, more than other occupational groups.
8. The upward trend in accidents involving Air Force personnel shown in the preliminary study and during the Emphasis Patrol period appears to have been reversed. There was a decrease in accidents in 1959 over 1958. There was a significant decrease in arrests for traffic law violations.
9. Approximately three out of four drivers involved in accidents were residents of Illinois. Illinois drivers had a slightly higher percentage of violations than accidents.

10. There appears to be a close relationship between traffic law violations and accidents. Each age group had approximately the same proportion of accidents as they had traffic violations. The 21-24 year old group had, by far, the worst record, having from three to five times as many accidents and traffic law violations as would be expected according to their proportion of the driving population. The accident and violation proportions progressively decrease after the age of 25.

11. Males have a worst accident record than females according to their proportion of the driving population in every age group except the under 18 year old group. Males had a much higher proportion of arrests for traffic law violations while females had a much lesser proportion according to their proportion of the driving population.

12. Approximately nine out of 10 accidents involved passenger cars. There was a marked improvement in the history of accidents involving trucks over the record shown during the preliminary study.

LIMITATIONS

A number of limitations are evident in this study, mainly because the principal writers were not consulted in its design. Some weaknesses are as follows:

1. The data for the Pre-Emphasis Patrol period was incomplete, making it impossible to make a complete comparison between the different years.

2. Weekly enforcement indices were not available for 1957 or for July, 1959.

3. Detailed traffic violation records were not available for the year 1957—the year prior to the Emphasis Patrol period.

4. Only the last six months of the year were studied.

5. The occupational groups were not broken down into specific job classifications.

6. The residence of drivers was given in three classifications: Air Force, Illinois and Other. Only two classifications should have been used, Illinois and out-of-state.

7. The proportion of Illinois to out-of-state drivers traveling the highway under study was unknown.

8. The proportion of drivers in different age groups traveling the highway under study was unknown.

9. The proportion of drivers by sex, traveling the highway under study was unknown.

10. Violation arrests for females by age were not given.

11. The type of enforcement maintained during the Post-Emphasis Patrol period did not remain constant. For example, the increased use of radar in 1959 made it difficult to make direct comparison between the years.

12. The proportion of types of vehicles traveling the highway under study was unknown.

IMPLICATIONS OF STUDY

1. The use of an Emphasis Patrol in other areas of high-accident experience should have the same beneficial effect if administered as conscientiously as in the present study.

2. A greater reduction of traffic fatalities could be achieved by still further increase of troopers and patrol units throughout the state of Illinois by giving greater coverage and concentration of enforcement.

RECOMMENDATIONS

1. Other studies of the effectiveness of Emphasis Patrols should be made, providing prior planning is done to eliminate weaknesses shown under the limitations of this study.

2. The enforcement index should be raised in all high accident-experience areas in Illinois.

3. More cars and troopers should be added to the Illinois Police force, thereby giving better coverage.

4. Each State Police District Commander should be supplied with spot maps for each county under his command, showing the time of day, day of week, month of year, and cause of accident, and with transparent overlay spot maps showing the same information for arrests of violators, in order to determine whether or not he is receiving the desired amount of the right kind of enforcement, and where Emphasis Patrols are needed or might be more expediently used.

REFERENCES

1. Most of the information contained in this preliminary study was made available from an office memorandum from Captain Kenneth Moore, Commander, Battalion #4, to William H. Morris, Superintendent, Division of State Police, dated June 20, 1958.

2. The enforcement index was obtained by dividing the total number of personal injury and fatal accidents into the total number of arrests for hazardous moving violations. Hazardous moving violations include all hazardous moving violations made by troopers on patrol plus all accident and radar arrests. This method of calculating the enforcement index gives a higher figure than would be obtained if the usual method of computing the enforcement index, using conviction with penalty rather than arrests, had been used.

3. All chi-square values are taken from the table in the following book: Allen L. Edwards. *Statistical Methods for the Behavioral Sciences*. New York: Rinehart and Company, Inc. 1956. p. 500.

4. Weekly indices were not available for 1957 or July, 1959.

5. A higher enforcement index is generally considered best. This does not hold true during a period of time when there are no fatal or personal injury accidents. When this happens the denominator is zero (0) and the quotient (enforcement index) is usually considered zero (0), although it is really indeterminate.

6. Detailed records of violations were not available for the year 1957. All comparisons of violations were made between the Emphasis Patrol period in 1958 and a regular patrol period in 1959.

7. Chicago *Sun-Times*. Saturday, March 26, 1960, Section 22, p. 22.

8. The accident index was computed by dividing the percentage of accidents in each age group by the percentage of drivers in that group. Thus an Index of 1.00 indicates that the group had the number of accidents that would be expected from that proportion of drivers. An Index of more than 1.00 would indicate that group had a poorer accident record than would be expected. An Index of less than 1.00 would indicate that group had a better accident record than would be expected.

APPENDIX A
Emphasis Patrol from July 1, 1958 until December 31, 1958

APPENDIX B
EMPHASIS PATROL—CHAMPAIGN COUNTY, Route 45
July 1, 1958 through December 31, 1958

		Sun	Mon	Tue	Wed	Thu	Fri	Sat
Fatal Accidents	2	0	0	0	0	0	1	1
Pers. Inj. Accidents	32	5	4	2	5	4	8	4
Prop. Dam. Accidents	42	11	4	3	5	3	8	8
Total Accidents	76							
Number Killed	3							
Number Injured	49							
Drivers Involved	144	4	13	30	47	22	6	122

		MALE — AGE						FEMALE — AGE							Drvs.	RESIDENTS			VEHICLE—TYPE				
		Under 18	18 to 20	21 to 24	25 to 44	45 to 65	Over 65	TOTALS	Under 18	18 to 20	21 to 24	25 to 44	45 to 65	Over 65	TOTALS	Arrested	Air Force	Illinois	Other	Passenger	Truck	Bus	Other	TOTALS
Mov. Haz. Arrests	1289																						
Non Haz. Arrests	377																						
Total Arrests	1666																						
Acc. Arrest %	.70																						
Enforcement Index	40.71																						
Police Manhours	19,892																						
Patrol Miles	467, 049																						
Speeding	892	23	88	160	406	142	8	827	65	66	14	53	217	542	892	722	168	2	892	424	161		
Illegal Passing	132	1	9	23	58	26	1	118	14	5	0	8	46	73	132	110	22	0	132	120	11		
Improper Turning	13	2	2	3	1	1	1	10	3	2	0	3	4	4	13	13	0	0	13	7	3		
Failure to Yield	24	1	3	5	9	3	1	22	2	4	0	6	6	8	24	21	3	0	24	18	2		
Disobeyed Stop	122	8	17	24	43	18	1	111	11	20	0	13	29	60	122	119	3	0	122	62	13		
Following Too Close	17	0	3	3	4	3	1	14	3	4	0	2	4	7	17	14	3	0	17	7	1		
Drunken Driving	29	0	2	3	17	5	0	27	2	10	0	0	5	14	29	29	0	0	29	16	6		
Other Mov. Haz.	60	3	3	11	29	9	1	56	4	14	2	3	10	31	60	56	4	0	60	36	11		
Op-Chauf. License	116	5	17	24	42	14	2	104	12	9	4	11	25	67	116	95	21	0	116	70	12		
Vehicle License	92	6	11	8	53	9	3	90	2	5	0	4	10	73	92	84	8	0	92	31	33		
Defective Equip.	35	4	11	7	12	1	0	35	0	6	0	4	5	20	35	34	1	0	35	22	5		
Other Non-Mov.	134	9	16	19	68	12	3	127	7	11	2	7	12	102	134	122	12	0	134	58	45		

		MALE — AGE						OCCUPATION						RACE				RESIDENTS	
		Under 18	18 to 20	21 to 24	25 to 44	45 to 65	Over 65	TOTALS	No. of Females	Air Force	Oth. Service	Students	White Collar	Misc. Labor	TOTALS	White	Negro	Other	TOTALS	July fig. unavail. Illinois	Other
Mov. Haz. Arrests	1289																				
Non Haz. Arrests	377																				
Total Arrests	1666																				
Acc. Arrest %	.70																				
Enforcement Index	40.71																				
Police Manhours	19,892																				
Patrol Miles	467, 049																				
Speeding	892	23	88	160	406	142	8	827	65	66	14	53	217	542	892	722	168	2	892	424	161
Illegal Passing	132	1	9	23	58	26	1	118	14	5	0	8	46	73	132	110	22	0	132	120	11
Improper Turning	13	2	2	3	1	1	1	10	3	2	0	3	4	4	13	13	0	0	13	7	3
Failure to Yield	24	1	3	5	9	3	1	22	2	4	0	6	6	8	24	21	3	0	24	18	2
Disobeyed Stop	122	8	17	24	43	18	1	111	11	20	0	13	29	60	122	119	3	0	122	62	13
Following Too Close	17	0	3	3	4	3	1	14	3	4	0	2	4	7	17	14	3	0	17	7	1
Drunken Driving	29	0	2	3	17	5	0	27	2	10	0	0	5	14	29	29	0	0	29	16	6
Other Mov. Haz.	60	3	3	11	29	9	1	56	4	14	2	3	10	31	60	56	4	0	60	36	11
Op-Chauf. License	116	5	17	24	42	14	2	104	12	9	4	11	25	67	116	95	21	0	116	70	12
Vehicle License	92	6	11	8	53	9	3	90	2	5	0	4	10	73	92	84	8	0	92	31	33
Defective Equip.	35	4	11	7	12	1	0	35	0	6	0	4	5	20	35	34	1	0	35	22	5
Other Non-Mov.	134	9	16	19	68	12	3	127	7	11	2	7	12	102	134	122	12	0	134	58	45

PATROL REPORT—CHAMPAIGN COUNTY, Route 45
July 1, 1959 through December 31, 1959

		Sun	Mon	Tue	Wed	Thu	Fri	Sat
Fatal Accidents	1	0	0	0	0	1	0	0
Pers. Inj. Accidents	34	4	6	3	5	1	5	10
Prop. Dam. Accidents	51	12	6	4	3	4	15	7
Total Accidents	86							
Number Killed	3							
Number Injured	60							
Drivers Involved	151	2	12	27	54	25	5	125

		MALE — AGE						FEMALE — AGE							Drvs.	RESIDENTS			VEHICLE—TYPE				
		Under 18	18 to 20	21 to 24	25 to 44	45 to 65	Over 65	TOTALS	Under 18	18 to 20	21 to 24	25 to 44	45 to 65	Over 65	TOTALS	Arrested	Air Force	Illinois	Other	Passenger	Truck	Bus	Other	TOTALS
Mov. Haz. Arrests	1436																						
Non Haz. Arrests	213																						
Total Arrests	1649																						
Acc. Arrest %	84																						
Enforcement Index	41																						
Police Manhours	4575																						
Patrol Miles	124,953																						
Speeding	1236	26	93	225	558	216	24	1142	94	80	2	70	310	774	1236	1163	73	0	1236	1006	230		
Illegal Passing	38	2	2	7	16	11	0	38	0	2	0	4	2	30	38	37	1	0	38	36	2		
Improper Turning	6	1	0	2	2	1	0	6	0	1	1	0	3	1	6	6	0	0	6	5	1		
Failure to Yield	30	0	3	3	12	10	0	28	2	6	0	5	9	10	30	29	1	0	30	26	4		
Disobeyed Stop	55	2	9	10	23	9	1	54	1	6	0	13	10	26	55	54	1	0	55	36	19		
Following Too Close	10	0	2	4	2	0	0	8	2	1	0	0	1	8	10	9	1	0	10	10	0		
Drunken Driving	31	0	0	1	18	10	0	29	2	4	0	0	9	18	31	30	1	0	31	25	6		
Other Mov. Haz.	30	2	2	7	14	4	0	29	1	7	2	6	6	9	30	29	1	0	30	23	7		
Op-Chauf. License	58	7	4	10	27	3	1	52	6	2	0	6	12	38	58	53	5	0	58	51	7		
Vehicle License	24	2	3	8	9	2	0	24	0	1	0	4	4	15	24	24	0	0	24	21	3		
Defective Equip.	36	2	6	12	13	2	0	35	1	4	0	6	11	15	36	34	2	0	36	28	8		
Other Non-Mov.	95	2	7	14	48	22	0	93	2	4	1	3	5	82	95	71	24	0	95	53	42		

		MALE — AGE						OCCUPATION						RACE				RESIDENTS	
		Under 18	18 to 20	21 to 24	25 to 44	45 to 65	Over 65	TOTALS	No. of Females	Air Force	Oth. Service	Students	White Collar	Misc. Labor	TOTALS	White	Negro	Other	TOTALS	Illinois	Other
Mov. Haz. Arrests	1436																				
Non Haz. Arrests	213																				
Total Arrests	1649																				
Acc. Arrest %	84																				
Enforcement Index	41																				
Police Manhours	4575																				
Patrol Miles	124,953																				
Speeding	1236	26	93	225	558	216	24	1142	94	80	2	70	310	774	1236	1163	73	0	1236	1006	230
Illegal Passing	38	2	2	7	16	11	0	38	0	2	0	4	2	30	38	37	1	0	38	36	2
Improper Turning	6	1	0	2	2	1	0	6	0	1	1	0	3	1	6	6	0	0	6	5	1
Failure to Yield	30	0	3	3	12	10	0	28	2	6	0	5	9	10	30	29	1	0	30	26	4
Disobeyed Stop	55	2	9	10	23	9	1	54	1	6	0	13	10	26	55	54	1	0	55	36	19
Following Too Close	10	0	2	4	2	0	0	8	2	1	0	0	1	8	10	9	1	0	10	10	0
Drunken Driving	31	0	0	1	18	10	0	29	2	4	0	0	9	18	31	30	1	0	31	25	6
Other Mov. Haz.	30	2	2	7	14	4	0	29	1	7	2	6	6	9	30	29	1	0	30	23	7
Op-Chauf. License	58	7	4	10	27	3	1	52	6	2	0	6	12	38	58	53	5	0	58	51	7
Vehicle License	24	2	3	8	9	2	0	24	0	1	0	4	4	15	24	24	0	0	24	21	3
Defective Equip.	36	2	6	12	13	2	0	35	1	4	0	6	11	15	36	34	2	0	36	28	8
Other Non-Mov.	95	2	7	14	48	22	0	93	2	4	1	3	5	82	95	71	24	0	95	53	42

400 "Queueing with Reneging"—F. A. Haight, Institute of Transportation and Traffic Engineering, U. of Calif., Los Angeles, Calif. Reprint No. 74; reprinted from *Metrika,* Band 2, Heft 3, 1959.

400 "Towards a Unified Theory of Road Traffic"—F. A. Haight, Institute of Transportation and Traffic Engineering, U. of Calif., Los Angeles, Calif. Reprint No. 68; reprinted from *Operations Research,* Vol. 6, No. 6, Nov.-Dec. 58.

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410 "Theoretical Studies and Operational Research on Traffic and Traffic Congestion"—R. J. Smeed. *Bulletin Internat'l. Institute of Statistics* (Stockholm, Sweden), Vol. 36, No. 4, pp. 347-375, 1958. (In English) *Road Abstracts,* Vol. 26, No. 8, p. 187, Aug. 59, and *Hwy. Research Abstracts,* Vol. 30, No. 2, pp. 12-13, Feb. 60.

411 "Monitoring Traffic Speed and Volume"—E. R. Ricker. *Traffic Quarterly* (Eno Foundation for Hwy. Traffic Control, Saugatuck, Conn.), Vol. 13, No. 1, pp. 128-140, Jan. 59. *Road Abstracts,* Vol. 26, No. 7, p. 167, July 59. *Hwy. Research Abstracts,* Vol. 30, No. 2, p. 7, Feb. 60.

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412 "Sampling Design for Fixed-Point Speed Measurements"—R. F. Crowther and R. P. Shumate. Proj. No. R-18 in cooperation with the Wisconsin State Patrol and the U. S. Bureau of Public Roads. A joint publication of the Traffic Institute of Northwestern U. and the Field Service Div., International Ass'n. of Chiefs of Police. 60.

412 "The Effect of Pneumatic Road Tubes on Vehicle Speeds"—The Traffic Institute of Northwestern U., 1804 Hinman Ave., Evanston, Ill. *A Report on Progress and Accomplishment, 1958-1959;* p. 24. A continuing project. Supported largely by funds from the Bureau of Public Roads and to some extent by general funds from the Traffic Institute.

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412 "Effect of Color and Location of Observation Car when Conduction Speed Checks"—J. E. Wilson and D. C. Chenu, Traffic Dept., Calif. Div. of Hwys. Reprint from *Traffic Engineering,* p. 46, Jan. 60.

415 "Traffic Characteristics of Roads Under Mixed Traffic Conditions"—M. Mori. *Traffic Engineering* (Institute of Traffic Engineers, 2029 K St., N. W., Washington 6, D. C.), Vol. 30, No. 1, pp. 23-28, 51, Oct. 59. *Hwy. Research Abstracts,* Vol. 30, No. 4, p. 8, April 60.

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432 "The Problem of the Amber Signal Light in Traffic Flow"—D. Gazis, R. Herman and A. Maradudin. *Operations Research* (Operations Research Society of America, Mt. Royal and Guilford Ave., Baltimore 2, Md.), Vol. 8, No. 1, pp. 112-132, Jan.-Feb. 60. *Hwy. Research Abstracts,* Vol. 30, No. 8, p. 8, Sept. 60.

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470.1 "Experimental Case Studies of Traffic Accidents"—The Traffic Institute of Northwestern U., 1804 Hinman Ave., Evanston, Ill. *A Report on Progress and Accomplishment, 1958-1959;* pp. 20-22. A continuing project, begun in 1957. Supported by funds from: U. S. Public Health Service, U. S. Bureau of Public Roads, and the Automotive Safety Foundation.

470.3 "Accident Analysis of an Urban Expressway System"—A. F. Malo, Dir., Dept. of Streets and Traffic, City of Detroit; and H. S. Mika, Supervisor, Engineering Research and Advanced Product Study Office, Ford Motor Co. *HRB Bulletin 240, "Highway Accident Studies,"* presented at the 38th Annual Meeting, Jan. 5-9, 1959 (Washington, D. C.) 60. (HRB: OR-293), pp. 33-43.

470.3 "Railroad Crossing Accident Study"—State of Nebraska, Dept. of Roads, Traffic Engineering Section, Accident Records Bureau. (J. W. Hossack, Acting State Engineer), Feb. 60.

470.32 "Accidental Injuries and Deaths in the United States"—Summary statement, by R. A. McFarland, Prof. of Environmental Health and Safety, Harvard School of Public Health and Dir., Comm. on Accidental Trauma, Armed Forces Epidemiological Board, Dept. of Defense, before the subcomm. on the Depts. of Labor, Health, Education, Welfare, and related agencies, of the Comm. on Appropriations, House of Representatives, J. E. Fogarty, chairman. Wash., D. C.

March 8, 60.

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470.32 "Accident Rates in the U. S. A."—*International Road Safety and Traffic Review* (World Touring and Automobile Organization, 32 Chesham Pl., London, S. W. 1), Vol. 7, No. 3, p. 28, Summer 1959. *Hwy. Research Abstracts,* Vol. 30, No. 2, p. 15, Feb. 60.

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471.11 "Child Injuries in Automobile Accidents"—J. O. Moore, B. Tourin, J. W. Garrett, and R. Lilienfeld. Automotive Crash Injury Research of Cornell U., (316 E. 61st St., New York 21, N. Y.), 1959. 13 pp. *Hwy. Research Abstracts,* Vol. 30, No. 5, p. 20, May 60. A preliminary report of this paper appeared in *Traffic Safety Research Review,* Vol. 4, No. 1, Mar. 60, under the title, "The Child in Injury-Producing Automobile Accidents."

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511 "New Directions for Enforcement in Furthering Traffic Safety"—L. Brody, Dir. of Research, Ctr. for Safety Educ., NYU. Presented at the 30th Annual Convention of the Greater New York Safety Council, Traffic Safety Session, March 28, 60.

511 "The One Driver License Plan"—G. V. Carmichael. *Traffic Digest and Review* (Traffic Institute, Northwestern U., 1804 Hinman Ave., Evanston, Ill.), Vol. 8, No. 6, p. 11, June 60. *Hwy. Research Abstracts,* Vol. 30, No. 8, pp. 20-21, Sept. 60.

511.02 "The Functions and Design of Motor Vehicle License Plates"—J. E. Baerwald, Prof. of Traffic Engineering; D. F. Karmeier, Research Asst. in Civil Engineering; and C. G. Herrington, Research Asst. in Civil Engineering. A report of an investigation by the Dept. of Civil Engineering, Engineering Experiment Station, U. of Ill. in cooperation with The Office of Charles F. Carpentier, Secy. of State, State of Ill. *U. of Ill. Bulletin,* Vol. 58, No. 10, Sept. 60. (Office of Publication, 49 Administration Building (West), Urbana, Ill.)

601 "Non-Directive Group Discussion Techniques in the Teaching of Driver Education in High Schools"—K. T. Sawers, doctoral dissertation; under direction of H. J. Stack, Ctr. for Safety Educ., NYU (Washington Square, New York 3, N. Y.) Spring 60.

602 "Organization and Status—College Safety Centers and Institutes, 1959-1960"—Based on reports submitted for the second meeting on College Safety Centers, Cornell U., Ithaca, N. Y., June 22, 1960. Ed. by D. P. Webster, staff representative for higher education, National Safety Council, (425 N. Michigan Ave., Chicago 11, Ill.).

611.2 "Status of Driver Education in the United States: A Study of Courses as Described by State and Local School Systems in Response to Special Inquiry"—N. Key, Secretary, Nat'l. Commission on Safety Educ. of the Nat'l. Education Ass'n. (1201 Sixteenth Street, N.W., Wash. 6, D. C.) 76 pp., 1960. (L. C. Card No. Mic 59-3441).

611.2 "The 1959 Pennsylvania Study of the Effectiveness of Driver Education"—Penn. Dept. of Public Instruction, Bureau of Research; (I. J. Stehman, Coordinator, Hwy. Safety Education). *Calculator,* Vol. 1, No. 7, (Harrisburg, Pa.), May 60.

640.1 "Development of Operational Level Basic Training Manuals"—The Traffic Institute of Northwestern U., 1804 Hinman Ave., Evanston, Ill. *A Report on Progress and Accomplishment, 1958-1959;* pp. 24-25. A continuing project. Supported largely by funds from the Bureau of Public Roads and to some extent by general funds from the Traffic Institute.

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844 "The Economic Cost of Traffic Accidents in Relation to the Human Element"—R. Dunman, Transportation Economist, Div. of Traffic Operations, Bureau of Public Roads. Prepared for presentation at the 39th Annual Meeting, Highway Research Board, National Research Council, Jan. 60.

844 "The Economic Costs of Motor-Vehicle Accidents in Relation to the Vehicle"—J. F. McCarthy, Transportation Economist, Div. of Traffic Operations, Bureau of Public Roads. Prepared for presentation at the 39th Annual Meeting, Highway Research Board, National Research Council, Jan. 60.

844 "The Economic Cost of Motor-Vehicle Traffic Accidents in Relation to the Highway Systems"—B. B. Twombly, Traffic Engineer, Commonwealth of Massachusetts, Dept. of Public Works, Traffic Engineering Div. Prepared for presentation at the 39th Annual Meeting, Highway Research Board, National Research Council, Jan. 60.

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He is a well-known lecturer and writer in Sweden as well as abroad. He has been recognized as an expert in traffic safety. In his writings and lectures, he has treated the problem of alcohol and traffic safety from the statistical, social, physiological, and legal points of view.

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Dr. Huffman has been on the staff of the University of Illinois since 1942. He received his bachelor's degree from Bridgewater College and his master's and doctorate from the University of Illinois.

He has taught numerous extension courses in safety and driver education for teachers in Illinois, and he is also engaged in research in these areas.

He is secretary of the research committee and a member of the executive committee of the higher education section of the School and College Conference of the National Safety Council. He is chairman-elect of the safety in school environment section of the American Association for Health, Physical Education and Recreation. Dr. Huffman is also an associate editor of the Association's Journal of Health, Physical Education and Recreation.

Lieutenant John T. Henry

Lieutenant John T. Henry is commanding officer of the Illinois State Police District Ten which is comprised of 10 east central Illinois counties, with headquarters at Urbana, Illinois.

He graduated from the Illinois State Police Training Academy at Springfield in June, 1950. Promoted to sergeant in November, 1951, he became a lieutenant and took charge of district ten in April of 1956.

He has completed safety education courses, and administrative work at the Police Training Institute of the University of Illinois.

Lieutenant Henry is a member of the Illinois Police Association, International Association of Chiefs of Police, and is the director of police services for the Illinois State Police Operational Survival Plan for Civil Defense.

A. E. Florio

Dr. A. E. Florio is a professor of safety education in the Department of Health and Safety in the College of Physical Education of the University of Illinois. His primary responsibilities are teaching undergraduate and graduate courses in safety and driver education, advising graduate theses and supervising the activities of the Safety and Driver Education Laboratory.

Dr. Florio received his bachelor's and master's degrees from the University of Illinois, and his doctorate from Columbia University. He has been on the faculty of the University of Illinois since 1935 and has been active in both state and national safety activities.

At present, he is chairman of the college education committee of the higher education section of the School and College Conference of the National Safety Council. He is past chairman of the driver education section, and was also a member of its executive committee. He is immediate past vice-president of the division of safety and driver education of the American Association of Health, Physical Education and Recreation. He is co-author of *Safety Education*, published by McGraw-Hill.

Dr. Florio is one of the founders of the Illinois Driver Education Association and has been awarded a life-time membership.

Jobe L. Payne

Jobe Payne has been on the staff of the University of Illinois since September, 1959. He is assisting in the driver and safety education work there.

He received his bachelor's and master's degrees in health education from the University of Illinois in 1955 and 1956, respectively.

From 1956-59 he was employed as a general science teacher in the Milwaukee, Wisconsin public school system.

H. Laurence Ross

Dr. Ross is a member of the Department of Sociology at New York University. He was formerly the behavioral scientist for Case Studies of Traffic Accidents at Northwestern University's Traffic Institute. His assignment on this project was to explore the applicability of sociological theory and research methods to the study of traffic accidents.

Graduated from Swarthmore College in 1955, he received his doctorate from Harvard University in 1959. During his graduate years, Dr. Ross served as research assistant to Samuel A. Stouffer and spent a year at the University of Chicago as a Fellow of the Social Science Research Council. His areas of special professional interest, as represented by his previous publications, are community structure and the social psychology of city life.